

NATIONALIZATION
AND THE
ZAMBIAN COPPER MINING INDUSTRY

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DECLARATION

I declare that this thesis has been composed by myself and is my own work.

Parts of the thesis, particularly material included in Chapter 2, 3, 4, 6 and 8, have been published previously in my work *The Copper Industry in Zambia* (Praeger, New York, 1981).

Simon Cunningham

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It bears stressing most emphatically that none of those who helped me bears any responsibility for any of the views expressed in this thesis or for any mistakes that might remain. Moreover, the views expressed in it are my own and do not imply expression of any opinion whatsoever on the part of any organization with which I might be connected.

ABSTRACT

This thesis examines whether the performance of a mineral industry in a developing country changed after its nationalization. The criteria for evaluating the performance of a mineral industry were set out at the beginning of the thesis, drawing on the economic theory of the exhaustion of mineral resources and on the considerations of how to determine efficiency that have been at the forefront of the recent debate about the efficiency of the private as opposed to the public sector.

The industry to be examined, the copper industry in Zambia, was then placed in its historical and economic context.

After compiling and describing the relevant data series for the entire period to be examined, 1960-1981, the performance of the industry before its nationalization in 1969 was examined. The reasons given at the time for nationalization and for the subsequent cancellation of the management contracts that the former private owners had been awarded were then analyzed, and, in the light of this analysis, the post-nationalization experience of the industry was examined.

Two important factors - the war in neighbouring Rhodesia and the collapse of the copper market - could be expected to have affected the industry's performance after nationalization and these were dealt with in a separate chapter.

Econometric work on production functions and cost equations produced results that were consistent with the earlier findings that the industry's performance did deteriorate after nationalization and especially after the cancellation of the management contracts.

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INTRODUCTION

This thesis looks at the performance of a state-owned natural resource industry in Africa - the Zambian copper mining industry - before and after nationalization.

At the present time, much of the world's attention is being directed towards Africa. The famine in the Horn of Africa and widespread hunger and malnutrition in almost all parts of Sub-Saharan Africa have touched the conscience of mankind and have brought forth enormous resources for emergency relief. At the same time as efforts are being made to solve the continent's immediate problems, thought is being given to the solution of its longer-term problems, for it is increasingly being realized that Africa's problems are deep-rooted and that considerable domestic adjustment is required as well as external support.

The International Bank for Reconstruction and Development (the World Bank) has taken a lead in organizing aid efforts for Africa and in proposing solutions to its longer term problems. Its report, Accelerated Development in Sub Saharan Africa: An Agenda for Action, first published in 1981, attracted considerable comment and criticism. It offered no general prescriptions, but as the Bank's President wrote in the Foreword, the report did suggest that "African governments should not only examine ways in which the public sector organizations can be operated more efficiently, but should also examine the possibility of placing greater reliance on the private sector." The President stated that this recommendation did not derive from "any preconceived philosophy of ownership. It derives from considerations of efficiency, which suggest that governments can more effectively achieve their social and development goals by reducing the widespread administrative overcommitment to the public sector...." ^{1/}

^{1/} World Bank Accelerated development in sub-Saharan Africa: An agenda for action, World Bank, Oxford University Press, 1981, page v.

The World Bank's criticism of publicly owned enterprises in Africa is reflected by much academic work which is being pursued at the moment into the rationale for and operations of publicly-owned enterprises. It is seen that these enterprises are an important fact of economic life, that their operations can make a difference to the national economy, and that it is not a matter of indifference whether enterprises are under private or public support.

Some work has been done on analysing the performance of publicly-owned enterprises in both developed and developing countries. In Great Britain, for instance, Dr. Richard Pryke tried to cover the field in his book Public Enterprise in Practice (London, Mac Gibbon & Kee, 1971). This work was quite sympathetic to the nationalized industries and found that in many respects their early performance was not unfavourable. However, his later study concluded that "A substantial waste of resources is obvious within the public enterprise sector due both to technical inefficiency and to misallocation.... even by British standards their performance appears to be poor" ^{2/} One of the reasons for the relatively poor performance of the nationalized industries was, according to Pryke, "the growing power of environmentalists and the growth of the belief, to which economists have greatly contributed, that the social and private interests of the nationalized industries frequently diverge." ^{3/}

In probably no industry is the possible divergence between social and private interests, which are a matter of great concern to environmentalists, greater than in the mining industry. Irrespective of whether they are nationalized or not, mining industries do have an environmental impact which most governments feel that they must take into account. Also, the mining

^{2/} PRYKE R. "Public Enterprise in Practice: The British Experience of Nationalisation during the Past Decade" in BAUMOL W.(ed.) Public and Private Enterprise in a Mixed Economy St. Martin's Press, New York, 1980, pg. 226.

^{3/} ibid. pg. 229.

industry is one in which society's interests - as represented by a steady income over a long period of time from the finite mineral resource - can prima facie be seen to differ from those of the private, and especially foreign, owner who is perhaps only interested in making the greatest profit in the shortest period of time.

In a mining industry in Africa such as we will be examining, all the concerns we have set out coalesce. Many of these industries have been nationalized, partly because of the belief that was set out in the United Nations' Charter of the Economic Rights and Duties of States ^{4/} that states had a permanent sovereignty over their natural resources and could therefore assume control over them from private, and especially foreign owners. The reasons given for the nationalizations that have taken place were not often environmental ones, in so far as few were criticized for polluting the environment, but rather socio-economic ones - that, once under government control, the enterprises would advance the interests of the worker and of the national economy better than in the time of private ownership. Finally, the economic performance of these industries after nationalization has often not been entirely satisfactory, as the World Bank suggested, and so questions are being raised about the relative efficiency of private as opposed to public sector enterprises.

Our thesis will compare the performance of the Zambian copper mining industry after as opposed to before nationalization as a contribution to the growing literature on private and publicly owned enterprises in the natural resource industry. We will have to take into account in our analysis all the different strands we have just mentioned.

^{4/} United Nations General Assembly Charter of Economic rights and duties of States A/RES/3281 (XXIX) December 12, 1974.

In the next and second chapter, we will set out more formally the economic issues briefly touched on above. We will look at the theory of the exploitation of a natural resource (and we use the word exploitation without any pejorative sense when talking of natural resources) with a view to seeing how the industry differs from other industries and how social and private interests might diverge. We will also see how the efficiency of the industry can be measured, as we would want to know whether in fact the industry was operated as efficiently, however this is defined, after nationalization as before.

Next, in chapter 3, we will set the particular industry we will examine, the Zambian copper mining industry, in its historical context. We will show how the industry was established and how it came to occupy the position which it occupied at the time of Independence, in 1964, and nationalization, in 1969.

Subsequently, in chapter 4, we will provide the economic context for the industry, by looking at its present importance for the world copper industry and the Zambian economy.

Having provided the background in these chapters, we will set out, in Chapter 5, the data which we will be using to analyze the performance of the industry in the period after 1960. This has merited a separate chapter, we felt, because of the numerous problems with the data.

In our next chapter, chapter 6, we use these data to help us analyze the performance of the industry in the period of private ownership from 1960-1969. We do this in the light, particularly, of the considerations that Chapter 2 had shown to be important.

Chapter 7 sets out the reasons given for the nationalization of the industry in 1969 and the cancellation, in 1973, of the management contracts that the Government had signed with the private owners at the time of nationalization. It is important to find out what, if anything, the Government expected from nationalization so that we will know which of the many possible objectives it did in fact set itself before we go on to examine its record in attempting to achieve these ends.

Chapter 8 analyzes the performance of the industry after nationalization. It is almost a mirror image of chapter 6, although it does take into account the discussion of chapter 7.

In the next chapter, we will look at some exogenous explanations for why the performance of the industry after nationalization was not as had been expected. Some of the major factors were the disruptions in the world copper market and the escalation of the troubles in neighbouring Rhodesia (now Zimbabwe) into a full-scale civil war that inevitably dragged in Zambia.

In Chapter 10, we will perform some econometric work on the data to assess whether the performance of the industry was different before as opposed to after nationalization. This will be done by looking at production functions and cost equations for the entire period 1960-1981 and seeing whether a dummy variable for the period of public ownership was significant and whether its sign indicated an improvement or deterioration in the industry's performance.

This was the last chapter in our analysis and, in Chapter 11, we try to set out the conclusions and to explain their significance.

Chapter 2

CRITERIA FOR EVALUATING THE PERFORMANCE OF AN INDUSTRY UNDER GOVERNMENT CONTROL

2.1 Introduction

This thesis will examine the economic justification for and the results of the nationalization of a natural resource industry in a developing country, that of the Zambian copper mining industry that took place in 1969. In a broad sense, we will be asking whether the country advanced its overall development objectives by taking control of its mining industry. Some of these objectives are outside the scope of our analysis, for it could always be argued that, irrespective of the cost, the country had to nationalize the industry as a matter of morality. Indeed, in 1980, the President of the country, Dr. Kenneth Kaunda, claimed that the ruling party had "domestically fought successfully against one of the two basic enemies of man ..., namely Exploitative International Capital and its offshoots of Imperialism, Colonialism, Neo-colonialism, Zionism, Fascism, Racism and Apartheid." ^{1/} Clearly the nationalization of the country's major industry which was owned by foreign, including South African, capital was seen, in 1980, as part of a larger struggle. However, at the time of the nationalization of the industry it was argued by economists ^{2/} and also by the Government that it would

^{1/} Republic of Zambia Project: "Operation Food Production" 1980-1990 State House, Lusaka, 23rd May 1980, page 2.

^{2/} cf FABER M.L.O. "A future for Zambia's Copper Industry", in Towards Economic Independence by FABER and POTTER J.G. Cambridge, Cambridge University Press, 1971. The paper was written in 1968, before nationalization.

benefit the industry and the country. Indeed, very few nationalizations are advocated as being likely to lead to an immediate or even long-term economic loss, but as being justified because of a broader objective such as advancing towards a more just and socialist society. It is, then, fair to concentrate simply on the economic benefits and losses of nationalization and to ask whether, on balance, the country gained by the measures it took. The time that has elapsed since the nationalization, over fifteen years, is probably sufficiently long to allow for a fair analysis. Such an analysis must, of necessity, be counter-factual, for it is impossible to know how well the industry would have performed if the Government had not changed the environment in which it operated.

In this chapter, we will set out the criteria by which we will judge the performance of the industry. We will first describe the motives for past nationalizations, so as to set the justification for the nationalization of a foreign owned mineral industry in its context. We will then outline the relevant parts of the theory of the exploitation of a mineral deposit by a private firm, so that we can see how the objectives a private company sets itself might differ from those that a government, determined to protect and advance the best interests of its citizens, would establish. The case made by opponents of nationalizations of foreign enterprises are usually the same: that any conflicts between private and state interests are likely to be small, and could certainly be resolved without nationalization and that, in any case, bureaucratic mismanagement, poor planning and inefficiency and the flight of foreign capital would very soon prove that the gains of nationalization were a

mere chimera. The previous analysis will enable us to set up the criteria to judge the performance and efficiency of the industry which we will subsequently use to see, in the first place, whether there was any economic rationale for nationalization at the time it took place and, secondly, whether, if there was, any subsequent deterioration in the industry's performance removed them.

2.2 Reasons for Nationalization

Before the present century, governments acquired and operated industries for national security reasons, such as in the case of armaments industries, or to enable them to discharge their specific duties as governments, as in the case of the acquisition of a building which has to be demolished to make way for a road. There was little question but that adequate compensation had to be paid.

In the present century, nationalization has been justified for broader reasons. The achievement of greater social and economic equality was an objective of many of the nationalizations that took place after the Second World War in both Western and, of course, Eastern Europe. Also, nationalization in market economies has been justified on economic grounds: in cases of a natural monopoly, such as the postal service, or of industries where externalities make private profit and loss calculations a misleading guide to the benefits conferred on society. An example of the latter would be a railway line that opened up the possibilities of commercial exploitation of previously neglected agricultural land.

Later, governments in developing countries took over industries that were owned by foreigners not only for economic and social reasons, but also for ones

of national pride. This was especially the case with industries that had been set up during the colonial period and whose continued ownership by foreign capital was felt incompatible with national aspirations and dignity. Because of the very strong resentment towards foreign control, governments have often been reluctant to pay the sort of compensation that the private owners felt they were entitled to. Moreover, the governments of the developing countries tend to argue that their own courts should decide on any disputes over the terms of compensation, whereas international corporations and most of the governments of the developed market economies argue that these disputes should be settled by international tribunals.

Almost certainly the industry that has generated the most emotion and litigation has been the mining industry. The concept that the developing countries have long been pressing is that of the state's "full permanent sovereignty over its natural resources". The New International Economic Order, adopted by the General Assembly of the United Nations in 1974, and reflecting the views of the developing countries, states that "in order to safeguard these (natural) resources, each State is entitled to exercise effective control over them and their exploitation with means suitable to its own situation, including the right to nationalization ... No State may be subjected to economic, political or any other type of coercion to prevent the free and full use of this inalienable right. "^{3/}

^{3/} United Nations General Assembly Declaration on the Establishment of a New International Economic Order A/RES/3201 (S-VI), paragraph 4(e).

2.3 The Economic Rationale of the Nationalization of Foreign-owned Mining Enterprises

2.3.1 Economic rent

Developing countries tend to feel especially strongly about their right to nationalize resource industries because the foreign operator is seen to be enjoying the economic rent coming from the exploitation of a mineral deposit which is the patrimony of the nation. As Ricardo defined it, this rent is the difference between the returns to capital coming from the poorest mine, which is only able to provide its owner with the usual or "normal" profits, and those coming from a more fertile mine. ^{4/} For instance, if a mine of one million tons of ore at 0.5% were the poorest mine worked and yielded its owner normal profits of \$100,000 per year, this being the minimum that he would accept for the expense and trouble of using his resources to exploit it, and an otherwise identical mine with ore of 4% yielded its owners \$5 million per year, then the rent of the second property would be \$4.9 million. The government could recover all this economic rent by nationalizing the property, thereby becoming the sole owner. This would result in a net gain if the costs of this exercise, primarily the payments, if any, it makes to the former owners for compensation and, perhaps, for managing the property, are less than the extra revenue it will receive from the property, with both payments and benefits being suitably discounted. ^{5/} The company would normally only sell

^{4/} RICARDO, D. The Principles of Political Economy and Taxation Third Edition, 1821, and Everyman Edition, 1974, page 46.

^{5/} cf MIKESELL R. The World Copper Industry Baltimore, Johns Hopkins University Press for Resources for the Future, 1979, pages 299-301.

its property if the selling price were greater than the revenue it expected to receive, but in very few cases does nationalization result from an agreement freely negotiated by both parties. The private owner knows that his property, the mine, cannot be moved and so can easily be confiscated. He can raise the costs to the government of this action by threatening to withdraw the skilled personnel required to operate the property efficiently or to involve his home government or to make it so clear that he felt that the nationalization was confiscation that prospective foreign investors would be frightened away. All these factors give him a stronger bargaining hand and would help to strengthen his inherently weaker position.

However, the government could, in theory, recover all the economic rent from the property simply by taxation and so the most that could be gained from nationalization, as distinct from taxation, would, in our example, be the \$100,000. This \$100,000, rather than being sent to foreign shareholders abroad, would be available for the country's development programmes.

2.3.2 Mining operations under private ownership

Nationalization is, though, not usually undertaken solely to recover normal profits, but to allow the state to "exercise effective control" over the country's natural resources so that they can be exploited in a different way from that in which private, and especially foreign, industry would exploit them.

We will first show how private industry is expected to exploit a mineral deposit by looking at a development of the theory of economic rent - the economics of exhaustible resources. This very broad branch of economics blends

the theory of stock management with elements of mining engineering, geology, the theory of cartels and risk analysis. ^{6/} We will only attempt to bring out those strands which will be of use for our subsequent analysis, and particularly in deciding which criteria to use when judging the industry's performance before and after nationalization.

Ricardo had treated production from mines on a level with that from land, with the implication that it should be increased up to a point where, assuming diminishing returns, marginal costs of production equalled marginal returns.

This was corrected, about a hundred years later, ^{7/} in 1914, in a seminal article by Lewis C. Gray who showed that:

" Ricardo was not justified in extending his theory of rent to exhaustible natural agents without modification, especially when the rent-bearer is exhaustible and non-restorable.

^{6/} Two fairly recent surveys of the literature were FISHER, Anthony C. and PETERSON, Frederick M. "The Exploitation of Extractive Resources: A Survey", The Economic Journal, vol. 87 (December 1977), pages 681-721; and ANDERS, G. et al The Economics of Mineral Extraction New York, Praeger, 1980, Chapter 2.

^{7/} It is understandable why it took such a long time for economics to approach the problem of the exhaustibility of mineral resources. At the time Ricardo wrote, vast areas of the present civilized world, such as America, were not even explored and mineral production itself was hardly at a point of exhausting world supplies: Britain, hard as it might be to believe now, was the world's largest producer of copper at the beginning of the 19th century.

During the course of the century, the frontier was everywhere closed and by the end there no longer remained vast areas of land that were uncolonized or totally unexplored. Furthermore, man's dependence on exhaustible minerals grew rapidly. In these circumstances, interest was bound to be re-awakened in mineral economics when it was felt that a particular country was in the process of exhausting its stock of a mineral of primary importance to it. In 1925, John Ise ("The Theory of Value as Applied to Natural Resources" American Economic Review Vol. XV 1925, pages 284-291) argued that the price of petroleum should be raised so as to reduce demand for it and encourage substitution.

For the location of the internal margin of utilization is determined by the competition of present and future uses rather than by the coincidence between product and expense" 8/

By the competition of present and future uses, Gray was referring to the fact that, even after allowing for inflation, future income is discounted relative to present income, and that the mine owner will try to arrange his production so that he could not increase his total welfare by shifting production from one period to another. In other words, he should not maximize his profits in any given period but rather the net present value of the stream of net income resulting from the deposit's exploitation.

In the case of a mineral deposit where the net income (i.e., receipts less costs) from production during the period t is V_t and the capital cost, incurred once and for all in the first period, after which production begins, is K_0 , then, with a discount rate of ' r ', the net present value of total production, B , is:

$$(1) \quad B = -K_0 + \int_0^T V_t e^{-rt} dt, \text{ when summed continuously. In the period } T,$$

the deposit would be exhausted.

Assuming for the moment that the production rate cannot change over time, there is likely to be a rate at which the net present value would be maximized because of decreasing returns to scale, and because capital costs should, after a point, rise exponentially since, to reach higher annual outputs, lower

8/ GRAY L.C. "Rent under the Assumption of Exhaustibility" Quarterly Journal of Economics, Harvard University Press, May 1914. Re-printed in Gaffney, M. (Ed.) Extractive Resources and Taxation Madison, University of Wisconsin Press, 1967, page 445.

grade ores would have to be treated. ^{9/} Generally, the larger the ore reserves and the higher their grade, the higher the rate of metal production should be.

Once the initial capacity had been installed, the operator could decide to obtain the maximum total profit over the life-time of the mine and so would produce where average costs were at a minimum, assuming, of course, that the cost-curve is U-shaped, thereby obtaining the greatest profit per unit of output. However, because of the discounting principle it would benefit him to increase production and therefore total profits per period, although this would mean producing at a higher unit cost and, because of the exhaustibility of the reserves, shortening the life of the mine. The mine would, then, produce at a rate between that at which average costs were at a minimum (the rate which would be chosen if future profits were not discounted) and that at which marginal cost equalled marginal revenue which, under conditions of perfect competition, would be equal to the price. The higher the discount rate, the greater the incentive to produce near to the latter rate, but, contrary to the implications of Ricardo's theory, this rate is not necessarily the optimum rate as it would be with a non-exhaustible resource like land.

When the assumption that the rate of production will be constant over time is removed the same considerations apply as before:- the operator would, because of the discounting principle, tend to increase the rate of production in the present even if this meant decreasing the rate in the future. Production should not, though, be increased when the increase in profits per unit of output was less than the "user costs" of production. These user costs per unit of output were defined by Anthony Scott as "the discounted value of

^{9/} For instance, to produce 50,000 tons of metal a year might mean treating 1 mn tons of ore, but to produce 100,000 tons treating 4 mn tons - thereby increasing substantially the surface plant needed.

the future profits foregone by a decision to produce a unit of output today"^{10/} and should increase with increases in present output as the mine would eventually have to be operated at a lower rate than that for which the plant was designed - i.e. at a position to the left of the minimum of the average cost curve - after which profits would progressively decline. On the other hand, the rate of increase in profits should decline with increases in output because of diminishing returns and so, at some rate of present production, there should be a maximum difference between profits and user costs and therefore an equality between their marginal increments.

User costs would further increase and so render less attractive increases in present production if the cost curves in the future were shifted upwards by these increases. This would happen if increasing production meant removing richer ore or ore nearer the shafts, leaving lower grade or less accessible ore for future extraction. The effect of an upward shift in the cost-curve, with price remaining constant, would be to reduce profits at every level of output and limit the range over which profitable production could be maintained (i.e. the levels of output where average costs were below price), and to lower the rate of production at which total profits per period were maximized (i.e. where marginal costs equalled price). The position of least cost production, though, would not be altered unless the shape of the average cost curve itself changed.

It is not only rapid increases in production that can raise future cost curves, for future increases in the costs of labour or of supplies, to the

^{10/} SCOTT A. "The Mine under Conditions of Certainty" in GAFFNEY M. *op. cit.* Pg. 34. Gray had a similar concept "It might be considered that the value of all coal extracted beyond the (point of maximum net returns per unit of output) is subject to an opportunity cost measured by the present value of the net return which would be derived from the coal if extraction were postponed until the future" (*ibid.* Pg 442).

extent that they were not off-set by future increases in the price of the metal, would have a similar effect. However, these increases, if unrelated to increases in present production ^{11/}, would lower the user cost schedule, as they would make future less profitable than present production, even before discounting, and so would encourage the firm to increase its production.

Another reason for present metal production exceeding future would be if the orebody contained richer ores near the surface which would be extracted before lower grade deeper ores. With a constant rate of ore production, metal production would in this case tend to decline over time. However, a company could be expected to try to avoid operating parts of its surface plant at under capacity in future periods and, therefore, would try to produce metal at a more uniform rate over the life-time of the mine. ^{12/}

Whilst the average grade of an ore stratum might decrease with depth, these strata are in many cases not of uniform grade but, starting from higher grade material in the centre, blend into waste rock. Present metal production could, then, be increased by pulling out only the richer ore (known as "high-grading"), but this would reduce the ultimate recovery of copper from the deposit as, in the case of an underground mine, it is impossible, because

^{11/} They would be related if, for instance, increasing present production meant paying higher bonus payments which became part of the normal wage structure subsequently, or if an increase in demand for supplies led to a permanent rise in their price.

^{12/} cf GRAY op. cit. Pg. 433.

of subsequent caving, to extract ore previously left behind. ^{13/} Not only, then, should the rate of production be considered as a variable when the enterprise sets up and operates its mining plant but also the ultimate recovery from the deposit (what will be called the level of recovery) and it should try to choose the combination of the two that maximized the net present value. If the rate of extraction were to be increased after that point, the positive effect on the net present value of shifting income towards the present would be more than off-set by the negative effect of losing sections of the orebody, and, similarly, if the level of recovery were to be increased, the net present value would fall. ^{14/}

The last point can be amplified by examining what the costs of production would be at a fixed rate of metal production when the level of recovery changes. The average of the costs that varied only with the rate of production and of fixed costs, such as plant maintenance, ventilation in the mines and administrative expenses, that can be a very high proportion of total costs in the mining industry, ^{15/} would fall as the level of recovery increased as they would be spread over a greater level. The average of the costs that varied with the level of recovery ^{16/} such as expenditure on

^{13/} Decreasing the cut-off grade can have a very substantial effect on reserves - increasing them by 18% for each 0.1% fall in the grade according to LASKY S.G. "How tonnage and grade relations help predict ore reserves" Engineering and Mining Journal 1950, cited by Sir R.L. PRAIN Copper : the Anatomy of an Industry Mining Journal Books, London 1975 Pg. 272.

^{14/} cf MCDONALD S.L. & McKIE J.W. "Petroleum Conservation in Theory and Practice" Quarterly Journal of Economics Vol LXXXVI 1962, pgs. 98-121.

^{15/} cf Mining Journal Mining Annual Review 1975 Pg 45.

^{16/} The concept of costs varying with the level of recovery was set out in detail by CARLISLE D. "The Economics of a Fund Resource with particular Reference to Mining" American Economic Review Vol. XLIV 1954, Pgs 595-616.

underground surveying and sampling, would probably fall initially with an increase in the level of recovery because, by mining and treating lower grades of ore to obtain the same metal output per period, the firm could operate at a larger and more efficient scale of operations. Later, these costs are likely to rise as these economies of scale would be offset by mining lower grade and less accessible ores and by attempting to increase the recovery rate at the treatment plant of the metal contained in the ore so as to offset the fall in grade.

If there were no time discount, then there would be no incentive not to remove all the ore whose treatment increased profits and so the operator would plan to increase the level of recovery until the marginal costs equalled the price (a result dissimilar to the one where the rate of production was the variable). With a positive time discount, the firm would wish to push income towards the present, towards the point where average costs were at a minimum and so would tend to ignore lower grade blocks of ore, thereby decreasing the eventual level of recovery. The lower the rate of extraction, the greater this tendency would be as it would take longer to extract these lower grade ores and so the value of their production, again given a positive time discount, would be smaller.

It is likely that less would be known about the costs associated with different levels of recovery than about the costs of extraction for given grades of ore and given sizes and locations of ore-bodies, and, therefore, when calculating an optimum strategy for developing a new deposit, the enterprise would compare several alternative levels of recovery each at its optimum rate of extraction and decide which yielded the greatest net present value.

Starting with the distinguished contribution of Harold Hotelling in 1931,
17/ attention has been increasingly concentrated on expressing mathematically the various factors described above. Formulae have been developed to express how present production should be increased so that the marginal increase in profits connected with a marginal increase in production equalled the marginal user costs,
18/ how investment should be increased until

17/ HOTELLING H. "The Economics of Exhaustible Resources" Journal of Political Economy Vol XXXIX April 1931 Pgs. 137-175.

18/ This is given by BURT O.R. & CUMMINGS R.G. "Production and Investment in Natural Resource Industries" American Economic Review Vol 59 1969 Pgs 985-989) as :

$$(3) \quad \frac{\partial V_t}{\partial Q_t} = \underbrace{\sum_{i=t+1}^{i=T} \frac{\partial V_i}{\partial R_i}}_{(1+r)^{i-t}} + \lambda_t + \sum_{i=t+1}^T \lambda_i \frac{\partial h(R_i, K_i)}{\partial R_i} \frac{1}{(1+r)^{i-t}}$$

Where V_t = profits from time t to time t+1
 r = rate of discount
 Q_t = reserves extracted from time t to time t+1 in tons of contained metal
 K_t = capital stock at beginning of time t
 R_t = reserves at time t (in tons of contained metal)
 T = time when reserves are exhausted.

As larger reserves and capital stocks allow larger rates of production, the authors introduced the inequality

$$(4) \quad Q_t \leq h(R_t, K_t)$$

This inequality has to be taken into account when optimizing present production and so a Lagrange multiplier, λ_t , giving the marginal cost in time t of the profits foregone because of this constraint, is included in the right hand side of the equation which gives the marginal user costs of present production. If the constraint were not operating during time t, then this expression would be zero. The third expression of the right hand side shows the discounted value of an incremental relaxation of the constraint in future periods (t+1 to T) when the relaxation is effected through an increment to reserves in each period. Finally, the first expression on the right hand side gives the discounted sum of an increment in profits associated with increasing reserves in each period after t and reflects the cost of using up reserves in current production, i.e. the cost arising from decreased levels of reserves in future periods and the associated higher costs of production as the resources is depleted.

its marginal cost in the present equals the discounted value of its marginal rewards in future periods ^{19/} and how both considerations should be combined when calculating the correct pattern of current investment and production. ^{20/}

^{19/} The authors gave this expression for this marginal equality between costs and rewards.

$$(5) \quad -\frac{\partial V_t}{\partial (dK_t)} = \sum_{i=t+1}^T \frac{\partial V_i}{\partial K_i} \frac{1}{(1+r)^{i-t}} + \sum_{i=t+1}^T \lambda_i \frac{\partial h(R_i, K_i)}{\partial K_i} \frac{1}{(1+r)^{i-t}}$$

where dK_t = additions to capital stock from time t to time $t+1$

The left hand side of the equation shows the marginal cost of capital investment and the right hand side its rewards, discounted to the present. The direct rewards are shown in the first expression as the marginal value of the capital stock in all future periods and the indirect rewards in the second expression as its effect in relaxing in future periods the constraint (4).

^{20/} The authors (BURT O.R. & CUMMINGS R.G. "Production and Investment in Natural Resource Industries" American Economic Review Vol LX 1970 Pgs 122-26) gave the following formula for the optimizing position:

$$(6) \quad \frac{\partial V_t}{\partial Q_t} - dK_t = b\gamma_1 \frac{(-\partial dR_t)}{\partial Q_t} + b\mu_1 \frac{(\partial dK_t)}{\partial Q_t}$$

Where b = discount function:

$b\gamma_1$ = discounted value of increments in reserves in all future periods associated with an increase in reserves during time t ,

$b\mu_1$ = discounted value of the increments to capital in future periods associated with an addition to the capital stock during period t ,

dR_t = additions to reserves from time t to time $t+1$

The left hand side of the expression gives the marginal value of current production and the right hand side the user cost - the first expression giving the discounted marginal value of a unit of reserves that is not extracted and devoted to current production and the second the marginal value of capital stocks that are consumed by an increment in current output.

However, their authors have found difficulty in applying them to explain the behaviour of enterprises, primarily because of the difficulty of fitting technical change into them. ^{21/}

Another problem is that of attaching any clear meaning to the concepts of marginal costs and returns in mining, especially when we are dealing with an industry and not with a single mine. A mining industry is usually a complex of open pit and underground mines, concentrators, smelters, refineries and numerous ancillary services ranging from creches for the children of mining families to hospitals and first-aid teams. It would be misleading to view any part or investment decision in isolation. For instance, if the ore in one mine changed characteristics so that the treatment plant could not deal with it effectively, it could pay to open up another mine. In this case the investment in this second mine is justified by the decrease in what would have been the costs of only using ore from the first mine. However, it is really impossible to assess what these would have been. Moreover, investment in this mine is not so much determined by the equation of its marginal costs with its marginal returns, as by its overall effects upon the whole mining system.

^{22/} Because of indivisibilities - that the decision is not whether to increase production slightly from the second mine, but whether to spend several million dollars on opening it up - and because of complementarities in the production process, it is, then, very difficult to use such marginal analyses.

^{21/} op. cit. (Note 18) Pg 989.

^{22/} For an excellent discussion of an enterprise as a system, see NOVE A. Efficiency Criteria in Nationalized Industries, London, George Allen and Unwin, 1973.

2.3.3 Differences between private and public developoment of mineral deposits

In any event, the debate over nationalization is not so much over those aspects of the theory of mineral exploitation but rather over whether a private company maximizing its own objective function, normally taken, as we have seen, to be the discounted flow of net profits over time, and subject to the constraints outlined above, conforms to the national interest. The arguments that it does not come under two headings - the first, that the private owner does not take into account all the factors that the government must - that in other words their objective functions contain different variables - and the second that it places different values on the variables mentioned above from those that a government would.

With regard to not taking into account all relevant considerations, it can be argued that a private company does not think of the normal externalities or of the industry's importance to the country as a whole. By externalities, we can think of such things as the pollution of nearby streams, or the benefits that farmers obtain from having a railway line to a mine built near their farms. By the private company's not considering the general economy, we can think of its not including in its calculations such factors as the education imparted to mine workers, or the need of the government to conserve its foreign exchange reserves by not buying from foreign suppliers when domestic suppliers could provide a similar good or service. In particular, the social and private valuations of labour costs can diverge substantially when there is substantial unemployment, or when the opportunity cost of the labour, perhaps due to low marginal productivity in agriculture, is below the private wage. A strictly profit and loss calculation could demand that a company employ foreign workers for skilled positions, keeping unskilled jobs for local employees, that it obtain its supplies from overseas

when a domestic industry, struggling to provide these services was only slightly less competitive, or that it close a mine which employed many thousands of people simply because the rate of return was not high enough. In all cases, we can see that the long run interests of the country could conflict with short run commercial interests.

In the case of a company controlled by a foreign monopoly or oligopoly, the case could be even stronger. Because of, for instance, a production reduction scheme, designed to boost the company's overall profits, its less profitable operations could be closed down. It could also decide not to exploit a mine in the country as this might cause a fall in the price of the mineral and, therefore, in the profitability of its other branches. On the other hand, it might be in the company's interests to encourage consumption of the mineral and so it could be prepared to accept a lower price for the mineral than the government would.

Many circumstances can be envisaged in which an international corporation's strategy dictated a policy towards the mining industry of a country which was different from that which the government would have pursued. Depending upon the product-mix of its overall output and the costs of production in the host country as against those of its other operations, the company could seek too small or too large a production from the mine compared to what national interests would appear to dictate.

In the case of many developing countries, an additional argument for the country's seeking effective control of the industry is that international corporations frequently see investment there as a very risky undertaking and so demand a very high rate of return on any new investment they are to make there; only pull out the high grade ore, leaving perfectly viable ore behind;

do not undertake prospecting even though the geological formations are very promising and repatriate profits rather than use them to expand capacity. There is a danger of circularity in this argument, because a government can create so hostile an atmosphere by its rhetoric and action towards other industries that the foreign owners of the mining industry will be very reluctant to risk their funds by further investment in that particular country, which will in turn justify nationalization as a way to force them to expand production.

Whilst a foreign company could be risk-averse because of political considerations, primarily the possibility of nationalization, any private company could be under a management which, perhaps, simply because of the passage of time, had become lethargic, sitting on mineral properties and not undertaking prospecting or mineral development. In this connection, it should be mentioned that several of today's famous mineral deposits, such as the porphyry deposits in North and South America, went through many different hands until they came into those of a skilled or bold entrepreneur who decided to go ahead and open them up. If a government felt that a risk-averse or lethargic company was sitting on possibly viable mineral deposits, or was not sufficiently bold in exploiting those known to exist, there would be a clear case for its reassigning them to other hands, including its own. Whereas a private company might be risk-averse, a government could argue that the national interest demanded that it take the risks involved in prospecting and mineral development.

The second economic argument for nationalization that we mentioned above is that the private owners would put a different value on some of the important variables than would the government of a country. Such is the case with externalities which would alter the value of V_t given in formula 1.

Also, it can be argued that the implicit rate of discount used would be different in the case of a private than of a nationalized industry. The government has to take a very long term view, it could be argued, so that future generations will benefit from a finite resource. In that case, the rate of discount to be used should be smaller than the one a company would use. On the other hand, it could be argued, especially in the case of a developing country, that its needs for capital now are so urgent because it has so many projects that it must finance in order to assure today's citizens a reasonable level of living, that a very high rate of discount should be used. It should then push income towards the present, even if this reduces the level of recovery from the mines.

2.4 Counter Arguments against those for Nationalization

Some of the above arguments in favour of nationalization have less validity in the case of the mining industry than in that of other industries. The mining industry is not one where the externalities are notably important such as in the case of transport, postal services or even education. Its output is not a public good but a good which is traded to foreigners on world markets and so normally has a clearly defined price and value. The industry can cause external diseconomies such as pollution, but it is possible to deal with these by legislation and compensation payments. It does bring benefits to a country, such as the education it provides to workers and the infrastructure that it has to construct, but so do other industries and, in any case, the government can pass legislation forcing the mining industry to employ certain numbers of local workers at specific levels of expertise and,

by granting tax concessions or other economic incentives, can encourage it to build infrastructure and to open up new mines. In sum, then, the mining industry is normally a large and important industry in a country but is not an obvious candidate for nationalization because of externalities peculiar to it.

Moreover, a proponent of the continued private control of the industry would argue that a privately run company is more accountable than would be a nationalized concern when it came to taking into account externalities: that citizens' action groups can complain to and obtain a sympathetic hearing from governmental bodies about excessive pollution or the lack of employment opportunities for locals, in the case of privately run enterprises, but in the case of nationalized concerns, they are likely to be met by bureaucratic obstruction and delay.

When it comes to possible conflicts of interest between a multinational corporation developing a country's mineral resources and the country itself, he would argue that the former's interests are most likely to conform with the latter's. Both would want an expanding market for the mineral at reasonable prices, whilst the multinational corporation can obtain greater access to international finance markets and to international expertise than could a nationalized enterprise. Given security of tenure, the company will invest in its properties and take a long term view of the industry, whereas a government is more likely to take a short term view of the industry, using revenues from the industry to bolster its own electoral or popular standing regardless of the long term interests of the country.

Moreover, the advocate of continued private control would stress that a high risk business like mining is best left to private rather than government enterprise. Adam Smith's argument of two centuries ago could be cited:

"Projects of mining, instead of replacing the capital employed in them, together with the ordinary profits of stock, commonly absorb both capital and profit. They are, therefore, the projects to which of all others a prudent law-giver, who desired to increase the capital of his nation would least choose to give any extraordinary encouragement, or to turn towards them a greater share of that capital than what would go to them of its own account". 23/

Not only is it not the proper role of a government to be involved in high risk operations, especially when it involves the major industry of the country, but it has frequently been argued that most industries, and especially the mining industry, is one best left in private hands, because of its complexities and the need for efficiency in its operations. As one proponent of this view, Dr. F. Taylor Ostrander of Amax Inc., when discussing the Zambian situation before nationalization, put it:

"The leaders of African states should understand that private foreign capital can serve their interests better than any nationalized enterprise. The essential economic rationale of private investment is its superior efficiency. As a test of profits in considering feasibility, as a means of organizing money, men, technology, and physical resources to achieve stated goals with a minimum of waste, as a means of recruiting technical skills and managerial talents, as a means of avoiding the overloading of limited numbers of indigenous administrative personnel, or, finally, but by no means least important, as a means of creating a larger stream of gross profits than bureaucratic enterprise ever could, and thus automatically of providing a broader basis for transfer of a fair share of profits directly into national budgets as freely disposable tax revenues - in all these ways, the superior efficiency of direct foreign private investment can bring many unique benefits to developing countries." 24/

Dr. Ostrander brought out the essential aspects of a mining enterprise that we outlined above - that it involves organizing resources to achieve specific goals. To produce copper in Zambia and to sell it to the outside world requires the talents of geologists, economists, caterers, physicists,

23/ SMITH, Adam. The Wealth of Nations London 1776/77 Book IV Chapter VII Part 1.

24/ OSTRANDER F.T. "The Role of Foreign Private Capital" in DAVIS John A. and BAKER James K. Southern Africa in Transition New York, Praeger 1966, page 351.

metal marketers, and hundreds of other traders. There have to be laboratories for testing the cores of ore drilled, libraries, first aid teams, garage and vehicle repair facilities as well, of course, as mines, smelters and refineries. In Africa, many of the facilities that would sometimes be provided by the local authority in a developed economy, such as recreational facilities or hospitals, also have to be provided by the mining enterprise.

The specific goal of constructing and operating this vast organization is to make profits for the owners by selling copper on the world market. What this clearly demands is not that each division make a profit or that all parts work continuously (one would hope, for instance, that the rescue teams did not) but that the system as a whole make a profit.

Obviously, it could be possible to increase profits for any period by, for instance, imposing longer work hours or high-grading, as described earlier. However, a proponent of private enterprise would argue that, given the initial resources available, and under comparable conditions, over time the benefits generated by a privately run enterprise would be greater than those generated by a government-run concern.

2.5 Growing Emphasis on "Market Forces" at the international level

2.5.1 The interest of World Bank

These views are gaining increasing importance because they are inspiring the lending decisions and the project proposals of the two most important international financial agencies, the International Bank for Reconstruction and Development (The World Bank) and the International Monetary Fund.

In its 1983 World Development Report, the World Bank devoted its special analytical section to "Management in Development". It stated that the:

"The main criterion for judging economic management is "efficiency" - a concept that has meaning only in the context of an agreed set of objectives. In every country efficiency has two distinct but related aspects that are critical to economic performance: efficient resource allocation ... and operational efficiency - to maximize the use of labour and capital through the sound management of enterprises ... in both the public and private sectors." ^{25/}

"The key factor for determining the efficiency of an enterprise" was not, the Report argued, "whether it is publicly or privately owned but how it is managed. In theory it is possible to create the kind of incentives that will maximize efficiency under any type of ownership. But there is a great difference between what is theoretically feasible and what typically happens." ^{26/}

After discussing the evidence, the Report concluded that:

"Government interventions can result in large losses in efficiency and should therefore be selective. In the face of compelling political and social pressures, governments will always be tempted to do more than can be accomplished efficiently. Yet today's widespread re-examination of the role of the state is evidence of a new realism." ^{27/}

Much of this re-examination was caused by the effects of the performance of state-owned enterprises on the national economy, in particular by their large and growing claims on the budget, ^{28/} and by their role as foreign borrowers. Indeed, on the page opposite to that on which this statement was made, a chart was given showing, for many developing countries, the net claims on the budget of non-financial state-owned enterprises, and in this chart, Zambia's net claims, as a percentage of GDP at market prices, were, in the years 1978 - 1980, considerably above those of all the other countries except Sri Lanka.^{29/}

^{25/} World Bank World Development Report 1983, New York, Oxford University Press, pages 41-42.

^{26/} ibid. page 50.

^{27/} ibid. page 56.

^{28/} ibid. page 74.

^{29/} vide ibid., Figure 8.1 page 75.

Generally, the Bank argues for abolishing price distortions, caused by subsidies or by unrealistic exchange rates, for restoring autonomy to the management of public enterprises and for opening them up to the challenges of competition, so that they would be on an equal footing in domestic and international markets with any other company. The rationale for this viewpoint is that:

"Efficiency is highest when an enterprise strives to maximize profits in a competitive market under managers with the autonomy, motivation and capability to respond to the challenge of competition." ^{30/}

2.5.2 The interest of the International Monetary Fund

The International Monetary Fund's attitude towards public ownership is similar to that of the World Bank. In a recent collection of three papers on public enterprise published by the Fund, the Managing Director, Jacques de Larosi re argued in the Foreword that the Fund had taken an interest in the problem when:

"The aggregate impact of inefficiency in the public enterprise sector as a whole or in a number of major producing units has resulted in budgetary deficits too large to be financed under conditions of monetary stability. In a number of countries the public enterprise deficit has been identified as a proximate cause of excessive credit creation, leading to monetary expansion, price inflation and, ultimately to balance of payments pressures." ^{31/}

As we will later see, the performance of the Zambian public enterprise sector, and particularly its copper industry, has received attention in the International Monetary Fund's adjustment programmes and targets have been set for the industry.

^{30/} ibid. page 74.

^{31/} FLOYD R.H. et al Public Enterprise in Mixed Economies: some macroeconomic aspects, International Monetary Fund, Washington, D.C. 1984, page V.

The Managing Director pointed to the paucity of data that developing countries publish on the public enterprise sector and its effect on the economy. The paper by R. P. Short in this volume did assemble some data at a very aggregate level. It is perhaps interesting that, of the sample of 78 countries examined, the public enterprise sector in Zambia accounted for the highest share of GDP at factor cost, 37.8 per cent in 1972, and the highest share of gross fixed capital formation, 61.2 per cent in 1979-80.^{32/} For many countries data were not available and even the data that were available were not necessarily comparable, but the figures quoted do illustrate the relatively large size of the public enterprise sector in Zambia.

2.6 Comparative studies on efficiency

These international organizations are being helped in their assessment of the performance of the public sector by many academic studies of the efficiency of public as opposed to private enterprises.^{33/} Generally, these studies have tried to see whether productivity in a publicly owned firm is different from that in a privately owned firm in a comparable situation. This can be done by estimating the production functions and seeing whether the returns to labour and capital are different, or the rates of technical progress are different, by looking at the cost functions to see whether their coefficients were appreciatively different, or simply by looking at indices such as output per head, or, in the case of railways, for instance, passenger miles or freight miles per input of labour, fuel, equipment.

In general, these studies can be useful in comparing industries in developed countries where there are public and private companies producing the same goods - such as public and private utilities, airlines and railways.

^{32/} ibid. pages 116-22.

^{33/} A recent survey of the literature is given in MILLWARD, R. et al Public Sector Economics, Longmans, London 1983, especially Chapter 5.

Data are often not a significant problem as these companies are usually compelled by law to publish voluminous statistics. The real problems here are to specify correctly the production and cost functions and to take into account any important exogenous factors that could affect comparisons.

This type of analysis is particularly suited for examining the operations of many small firms or enterprises in the same industry. For instance, garbage collection in the United States is undertaken by municipalities directly, by private firms that bid for an exclusive contract from the municipality or simply by private firms that come to an agreement with the individual householder. By comparing the costs to households of these services in many different cities, an idea of comparative efficiency can be reached. Such studies were examined by Professor E. S. Savas who found that private contract work was more efficient than municipal collection^{34/}.

In our study, we will not be comparing the industry to be studied with another comparable industry, if there were one which, given differences in the grades, metallurgical properties and the shape of the ore bodies being mined, would be highly unlikely. Rather we will be comparing the performance of the industry before nationalization as opposed to after nationalization. Analysis of the production and cost performance of the industry is supplemented by econometric work which employs dummy variables to account for the difference between the pre- and post-nationalization periods. The study is not based entirely around this econometric work, because the whole environment in which

^{34/} SAVAS E. S., "Comparative Costs of Public and Private Enterprise in a Municipal Service" in BAUMOL W. (ed.) Public and Private Enterprise in a Mixed Economy, St. Martin's Press, New York, 1980, pages 253-264.

the industry operated changed very quickly after nationalization. Much of our study will be concerned with examining what effect these changes could have been expected to have had on the industry

Another reason why econometric work will only form part of our analysis is that it is difficult to assume, in the case of the mining industry, that production functions and cost relationships do not change over time. As we argued earlier in this chapter, lower grades of ore, greater mining depths and problems of reserve depletion can all be expected to affect these functions, and although some attempts are made to allow for these effects, lack of data prevents more comprehensive work.

2.7 Summary: Criteria for Evaluating the Performance of the Mining Industry under Private and Government Control

In the light of the above discussion, a first criterion that suggests itself for measuring the relative performance of the industry under private and Government control is the surpluses it generated and the tax revenues that it provided the Government. We will also have to see whether these surpluses came from producing a steadily larger volume of copper and whether the funds for expansion came from internally generated funds or, less optimally, from overseas loans. If the former were unavailable, the ability of the different companies to attract loans must also be considered as important when assessing relative performance.

Looking more closely at the industry's performance, we must ask whether the companies lengthened the life-time of the industry and, therefore, total profits by treating a declining grade of ore over time, whether they improved the efficiency of their treatment processes so that they obtained a steadily

greater recovery of metal from each ton of ore hoisted and whether they were energetic and enterprising in undertaking exploration programmes. We must ask whether increasing amounts of investment were needed to produce additions to production and also whether the labour force expanded more rapidly than did production. All the above indicators, except the first, should give us measures of efficiency. The ore grade is not so unambiguous a test of performance because for economic reasons, as discussed earlier, a government might want to push income towards the future and therefore might increase the cut-off grade. Other things being equal, though, being able to treat a declining grade of ore over time is a sign of increasing efficiency. As just stated, we will try to combine many of these variables in econometric tests on the production and cost functions, so as to come up with an overall picture.

It cannot be too strongly stressed that mining is not primarily a question of technical efficiencies but rather of achieving a steady flow of net income from a mineral deposit under conditions of uncertainty. These uncertainties are manifold. Those connected with prospecting are clear: even the most vigorously conducted exploration campaign can reveal nothing, if there was nothing to find. Mining itself is an uncertain activity in that, as it progresses, new facts can be found about the ore body; that the seam thins out with depth, or that it buckles, that the mine is more liable to flooding or that the ores are more difficult to treat. Some of these factors, but not all, could have been determined by the preliminary drilling. Lastly, and perhaps most importantly, the final product, a metal, is subject to the vagaries of the international market, to demand shifts caused by, amongst other things, the effects of oil price increases on the economies of the major

consuming countries, and the supply disruptions caused by strikes, floodings, and even wars. It is the function of a mining company to anticipate as best it can changes in the price of its product, but always to bear in mind that the eventual price could be very different from that which it had forecast. One of the most important tests of management is its ability to read the market and to act accordingly, adjusting its investment plans when the need arises. In looking at the performance of the Zambian copper industry, we must come to some assessment as to whether the private owners were more realistic than the nationalized industries' managers in acting in a very uncertain environment. We must also take the changing environment into account throughout our discussion: it would, for instance, be unfair to argue that the Government's not expanding production as quickly as did the private owners was a clear sign of an inferior performance if several mines suddenly encountered severe drainage problems and other technical difficulties at the time of the take-over.

Having examined these commercial and technical aspects of running the mining industry, we will address ourselves to the issues which the Government itself felt important. As we saw earlier, depending upon the circumstances, a mining company can be seen to be expanding production too rapidly or too slowly. - Also to answer whether the performance of the industry improved from the Government's point of view after nationalization, we must first find out what its objectives were at the time and what externalities it felt to be of particular importance.

Chapter 3

THE DEVELOPMENT OF THE ZAMBIAN COPPER MINING INDUSTRY

In this chapter we will briefly review the history of the industry up to the time of Independence and nationalization.

The Zambian mining industry did not rise slowly to the position of dominance it now enjoys in the economy and of importance it holds in the world copper market because, once it had been firmly established in the late 1920s, the country's economic prosperity has been inextricably tied to it. ^{1/}

3.1 The pre-1914 search for minerals in Central Africa

However, before the First World War an effort had been made to set up a copper industry with disappointing results, since all the mines opened up were eventually closed down. One factor that justified mineral exploration and exploitation in Central Africa at this time was the previous dramatic increase in the world's demand for copper to be used as a medium in the generation and transmission of electricity. World production, which had totalled 163,000 tons between 1801 and 1810, rose to 3,707,000 between 1891 and 1900. Moreover, the period 1894 to 1907 was one of a generally rising copper price.

In this period, Zambia's mineral rights were held by a private company, the British South Africa Company, founded in 1888 by Cecil Rhodes and which, until 1924 also administered the country under a Royal Charter granted by the British Government. The Company closed the country to individual prospectors and granted exclusive prospecting rights over given areas to companies or

^{1/} This chapter is largely drawn from a previous work by the present writer, The Copper Industry in Zambia, Praeger, New York, 1981.

individuals who had to be adequately backed and to spend a specified sum on exploration. ^{2/} The various prospecting licenses issued totaled about 30 and eventually found their way into the hands of seven companies.

The explorers these companies financed found many deposits, including some of the largest of the present-day producing mines - Roan Antelope, Nkana and, possibly, Nchanga. Yet they failed to recognize that beneath their low grade oxide outcrops lay massive sulphide ore-bodies and so did not examine them by drilling. Instead the companies opened up Bwana Mkubwa and Kansanshi in the north and even smaller deposits at the Hook of the Kafue, in the middle of the western half of the country. All these deposits were soon seen to be of little value. Public interest then declined precipitately, especially after the fall in the price of copper in 1907.

There are several partial explanations for the failure to recognize the true value of the really worthwhile deposits. One of them is that the management of the companies was defective. Sir Edmund Davis^{3/}, a senior director and later Chairman of two of the most important companies, the Northern Copper Company and the Rhodesia Copper Company, was unwilling "to

^{2/} T. D. GUERNSEY, "Summary of Early Prospecting in Northern Rhodesia", Transactions of the Institution of Mining and Metallurgy 63 (1953-1954) 1-8 contains an excellent summary of the legal framework and course of pre-1914 exploration.

^{3/} DAVIS, Sir Edmund (Kt 1927) (1862-1939). Born in Australia, emigrated to Cape Town at age of 17. Founded Bechuanaland Exploration Company in 1888. This company was originally a rival of Rhodes' British South Africa Company but the two companies worked together in Northern Rhodesia, forming the Northern Territories (B.S.A.) Company in 1895. Became a director of the Chartered Company in 1927 and of Anglo American Corporation in 1928. Avid art Collector. High Sheriff of Kent after 1930.

risk big money" ^{4/}, whereas, proper examination of the deposits would have entailed risking substantial sums, conducted his businesses inefficiently, trying to organize everything from his office in London, 7,000 miles away, and was technically inexperienced, more interested in the companies being formed as "business propositions on paper" than as enterprises mining copper in the heart of Africa ^{5/}.

Certainly it was not the limited availability of capital that prevented management from directing the exploration effort towards the deposits of most real interest, for capital was more readily available for speculative ventures before as opposed to after the First World War. Also, physical difficulties cannot be considered an important explanation since British explorers coming from Zambia discovered the mineral wealth of the Katanga in 1901. Moreover, the personnel employed in the field were not obviously unqualified. For instance, Dr. Davey, Consulting Engineer to most of the exploration companies, was a man of wide experience in the mining world. ^{6/}

However, the early explorers failed to notice, or at least to take account of, the geological differences between the Katangan and Zambian ore-bodies. Katanga's high grade oxide ores occurred in dolomite rocks which

^{4/} GREGORY, Sir T. Ernest Oppenheimer and the Economic Development of Southern Africa, Cape Town, Oxford University Press, 1962, pages 399-400, 408.

^{5/} MURRAY-HUGHES, J. "Sir Edmund Davis" Northern Rhodesia (Zambia) Journal, Volume VII, 1965, pages 1-12, gives an account of Davis' financial manipulations.

^{6/} GUERNSEY op. cit.

opposed the development of secondary copper sulphides. However, Zambia's low grade surface oxides - rarely over 7 per cent, a grade that would have been discarded in the Katanga where 15 per cent ores were being worked - occurred in siliceous rocks and under acid conditions which were ideal for their development. ^{7/}

Sulphides had, though, been found in Zambia - the Sable Antelope mine in the Hook of the Kafue, for instance, contained on the surface a lode of high-grade sulphide ore. Also, the fact that the Katangan ores occurred in dolomite rocks whilst those of Zambia occurred in siliceous rocks had been noticed. ^{8/} Furthermore, Dr. Davey, when answering the question why the ancient mines had not been worked to greater depths, said that "at depths ranging from only a few inches to over 100 feet" the oxidized copper ores gave way to sulphides and that: "We have invariably found that the depth of the old workings is limited by the appearance of sulphides of copper so that they form no criterion as to the depth to which the copper deposits might extend".^{9/} Indeed, in the case of Roan Antelope, he had realized that the

^{7/} Rhodesian Anglo American Ltd. Mining Developments in Northern Rhodesia, Broken Hill, 1929. This pamphlet was written by Dr. J. A. Bancroft.

^{8/} Vide STUDDT, F. E. "The Geology of the Katanga and Northern Rhodesia" Proceedings and Transactions of the Geological Society of South Africa, Volume XIV, 1913, pages 44-106.

^{9/} DAVEY, T.G. in a Report to the Northern Copper Company, London, 31st December 1902 page 2 quoted in WALKER, G.L. Notes on the Copper History of Central Africa, RST archives W(2) HA Group (henceforth RST archives). Davey was not stating facts that were not available to interested parties. In the 1907 Annual Report of the Rhodesia Museum at Bulawayo, F.P. Mennell, F.G.S., tried to help the work of the prospector by writing on the "Mineral Wealth of Rhodesia" and made exactly these points, whilst stressing that the Museum would be only too willing to analyze samples that were sent for analysis.

deposit might be synclinal, i.e., that the ore extended in a continuous band beneath the surface between the parallel Roan Antelope and Rietbok outcrops - and early prospecting shafts had actually been sunk deep enough to reveal the sulphide ores underneath the surface oxides. ^{10/}

3.2 The post-1918 discovery of the country's mineral wealth

Sulphide ores became considerably more attractive than oxide ores with the development of the froth flotation method of concentration. This was first introduced on a commercial scale in 1912 at El Teniente mine in Chile by Minerals Separation Ltd. of London. The recovery of copper from the mine's ores improved from 50 to 90 per cent. Minerals Separation Ltd. was to play a decisive role in the development of the Northern Rhodesian copper industry after the First World War.

The story began in 1918 when P.K. Horner and C. Gordon James ^{11/} were made redundant by the Union Minière du Haut Katanga, the company founded in

^{10/} FORD, S.H. Letter to D.C. D'Eath, 10 January 1950, in RST archives op. cit., Document 476, and PARKER, R.J. in Reply to the Discussion on "Prospecting and Geological Survey of the Nkana Concession, Northern Rhodesia 1927-1929" Transactions of the Institute of Mining and Metallurgy, Volume XLV, page 353: "the original (1902-1907) prospectors discovered the sulphides at Roan. They undoubtedly sampled their development work and they could not have explained the copper content at the bottom of the shafts without knowing that sulphide ore was present." Parker discovered the true value of the Roan mine in 1925-1926.

^{11/} Cf. PARKER, R. and GRAY, A. "Prospecting and the Geological Survey of the Nkana Concession" Transactions of the Institution of Mining and Metallurgy, Volume XLV, 1936, page 319: "It was entirely through the activities of P. K. Horner and C. Gordon James that Copper Ventures was formed (under the aegis of Minerals Separation Ltd.) to investigate some of the old copper discoveries and to test the possibility of finding new deposits through intensive and scientific prospecting". Parker had no time for Horner and would only have given him credit where it was due.

1906 to exploit Katanga's mineral wealth. It had sufficient capital to set up treatment plant and to attract skilled American and British engineers like these two. Horner had been Directeur Général of the company and James had worked there as a metallurgist. In the latter part of 1920, they met in London, W. G. Perkins ^{12/} who had developed a process to treat low grade oxide ores with ammonia. He too had been in the Katanga and also knew Horner from his days in America and discussed with him the possibilities of using his new process on deposits in the Katanga. As a result, Horner approached Union Minière for a concession but, when this plan fell through, thought instead of an exploration syndicate.

The idea of a syndicate was brought to reality by Captain William Broadbridge, the Chief Engineer of Minerals Separation Ltd. This company had tried between 1919 and 1920 to apply the froth flotation method of concentration to Bwana Mkubwa's oxide ores, but without success. When Perkins discussed with Broadbridge his own process and Horner's ideas for a syndicate, he became enthusiastic and suggested that they look into the possibilities of using Perkins' process on Bwana Mkubwa's ores.

Another person who joined the exploration syndicate was Alfred Chester Beatty. Beatty, who had played a major role in helping the Guggenheims develop the porphyry copper deposits of North and South America, was probably the world's foremost authority on the mining and treatment of copper ores. In

^{12/} We follow the account of the formation of Copper Ventures Ltd. given by Horner and James in the RST Archives op. cit. Bancroft (Mining in Northern Rhodesia, London and Salisbury, British South Africa Company, 1961, pages 147-148) gives a different story of James overhearing a conversation on the Nkana claims when in hospital in Broken Hill and returning to London to interest his friend Horner in them.

1913 he had left his U.S. mining interests to settle in England. Using his own capital he formed, in December 1914, his own mining house, Selection Trust, which initially was engaged in prospecting for diamonds in Ghana and Angola. Perkins had an office in Beatty's Selection Trust building and so was able to introduce Horner to him. Beatty's previous experience was with deposits very different from Bwana Mkubwa - with huge deposits of fairly low grade sulphides that were amenable to flotation - and, apparently, his interest in Zambia stemmed from the hope that such deposits might be found there. Copper Ventures and Bwana Mkubwa provided him with an entree into Zambia. Even so, knowing that there would be great difficulties in exploiting the low grade oxide ores known to exist there, he told Horner that he would only be interested in his plans if these ores could be successfully treated and subscribed £250, half the cost of the experimental treatment plant. The plant was very successful and so Beatty agreed to join the syndicate, when, under the name of "Copper Ventures Ltd.", it was formed in November 1921 to "carry on business as metallurgists". The original capital of the syndicate was £5,000, half of which was subscribed for by Minerals Separation Ltd.^{13/}

As well as trying, in the end unsuccessfully, to apply Perkins' process to Bwana Mkubwa's ores, the Copper Ventures Syndicate undertook fresh exploration and examined more carefully known deposits, in particular, Nkana. There is some dispute as to what exactly it accomplished, and particularly whether it would have achieved more if it had had larger resources, but by the time that it was wound up, in March 1925, and its interests were distributed

^{13/} The final participation in Copper Ventures Ltd. was - Minerals Separation Ltd. 43 1/3 per cent; Webster and Broadbridge of that company, 6 2/3 per cent each; Horner 8 per cent; Perkins and James 10 per cent each, Selection Trust 13 1/3 per cent; Selection Trust directors 2 per cent (RST archives op. cit., Document 122).

pro rata to its shareholders, (the main interests of the Syndicate are given in Figure 3.1) a firm basis had been established for successful exploration.

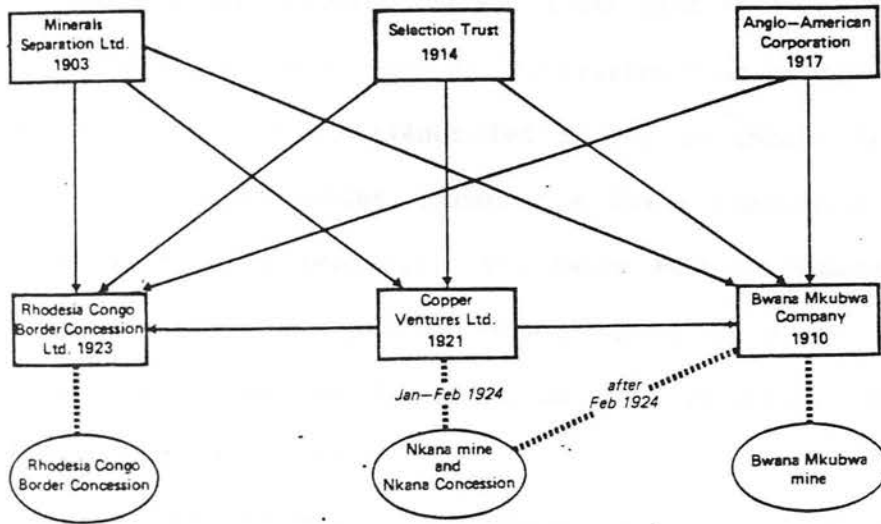
The Syndicate had obtained from the British South Africa Company exclusive prospecting areas and exploration in two of them - the 1,800 square mile Nkana Concession, which it obtained in 1924 and the much larger, 50,000 square mile Rhodesia Congo Border Concession it obtained in 1922 - had revealed the Mufulira and Nchanga deposits. The Syndicate's drilling had shown the presence of clean sulphides at Nkana. Also, Sir Edmund Davis and Chester Beatty had been able to interest Sir Ernest Oppenheimer, Chairman of the Anglo American Corporation of South Africa, in investing in the Bwana Mkubwa Company and Rhodesia Congo Border Concession Ltd. which had been formed to explore the concession of the same name. Sir Ernest's main interest was in diamonds, and he had agreed to invest in Zambia as a favour to Sir Edmund for acting as an intermediary in negotiations with Zairean and Angolan diamond producers.

It was Chester Beatty who was responsible for removing any doubt as to the importance of the Zambia copper fields. After the dissolution of the Syndicate, he obtained option on thirty properties, including Roan Antelope, and acceded to the requests of his subordinates, Russell Parker and William Selkirk, to drill that property. Selkirk's method of drilling was to sink widely spaced holes 1,000 feet apart. This was new to copper mining but was decided upon because he believed that he would find a large and uniformly disseminated ore body. ^{14/} The first hole that was sunk justified this procedure, for it reached the ore shale formation at 457.75 feet and passed

^{14/} BRADLEY, Sir K. Copper Venture, London, Mufulira and Roan Antelope Mines, 1952, page 83.

Figure 3.1

The Corporate Structure at the Time of Copper Ventures



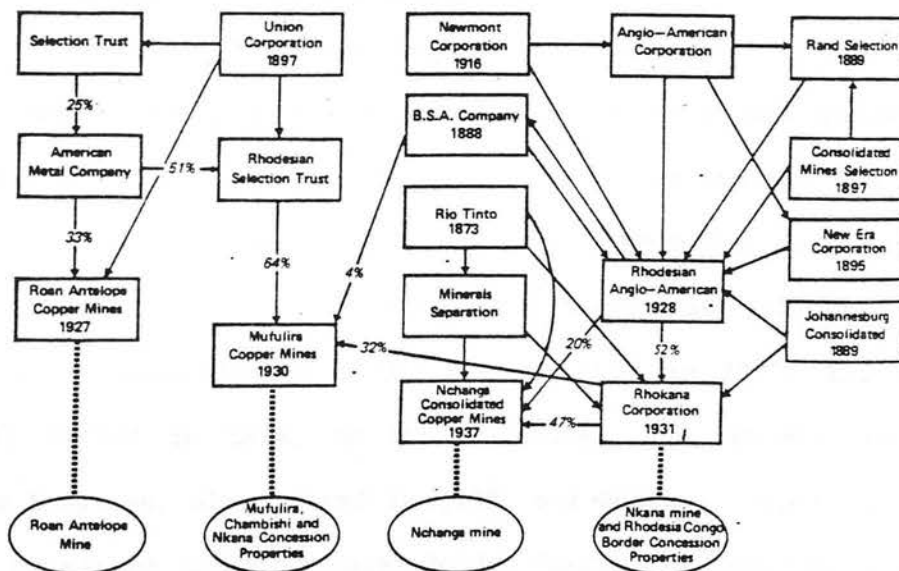
NOTES: Only the more important company relationships are given:

————— Indicates ownership in a company

..... Indicates control of a property

Figure 3.2

The Corporate Structure before the Second World War



out at 497.50 feet, revealing an ore body of 3.87 per cent copper in clean sulphides, with a true width of 36.5 feet. There was no longer much question about the value of the Roan Antelope Mine: 3 per cent to 4 per cent sulphides in such a wide formation could be more easily treated than oxides.

The success of the Roan drillings led Beatty to obtain from the Bwana Mkubwa company, which had earlier bought the Nkana Concession from Copper Ventures, an option on that property. The Bwana Mkubwa company insisted on retaining a 1/3 interest in any property found, which was a very wise decision as the Mifulira and, after the Second World War, Chibuluma, Chambishi and Baluba mines were developed in that area.

Chester Beatty did not have the finances to examine the Nkana deposit itself or even the Nchanga deposit, the most promising one in the Rhodesia Congo Border Concession, and it was the Anglo American group, assisted by engineers from the Newmont Corporation, which examined and developed these properties in the early days.

3.3 The formation of the large copper companies

The story of the battle for control of the emerging mines has been told elsewhere. It was feared that the whole of the Zambian copper industry would come under the control of the American copper companies who had the expertise and the capital to develop the mines. As it was, both American capital and expertise were used to bring the mines on stream but all the operating companies - Roan Antelope Copper Mines Ltd., formed in 1927, and Rhodesian Selection Trust formed in 1928, on the one side; and, on the other side, Rhodesian Anglo American, also formed in 1928, and Rhokana Corporation, formed in 1931 by the merger of Rhodesia Congo Border Concession Ltd., Nchanga Copper Mines Ltd. (itself formed in 1927), and the Bwana Mkubwa Company (which

controlled the Nkana mine) - were British companies with head offices in London. The first two companies were heavily supported by Chester Beatty's friends, the American Metal Company. Rhokana was controlled by Rio Tinto Zinc and the Anglo American Corporation and its friends, including the Newmont Corporation. South African, British and, through Newmont, American capital backed Rhodesian Anglo American. In 1930, Selection Trust exchanged all its shares in its Zambian properties for a direct interest in the American Metal Company and so its interest was henceforth only indirect. However, until 1953, when the companies changed their domicile to Zambia, Selection Trust continued to operate the properties from its London office. The only direct connection between the two groups was the $\frac{1}{3}$ interest that Rhokana Corporation held in the mines of Rhodesian Selection Trust. The main inter-company relationships at the time of the Second World War are given in figure 3.2.

It was fortunate that the mines were backed by powerful interests because they were coming on stream at the very time that the Depression, which led to a collapse in the copper price, started (see Table 3.1). The American Metal Company almost went bankrupt in financing the development of the Roan Antelope and Mufulira properties. ^{15/} As it was, the Depression and the wartime controls on dividends and profits made the Zambian copper properties, in retrospect, very poor investments. In the case of the first mine opened up, Roan Antelope, it was only in 1948, after 17 years of production and 21 years after the company was first floated, that the total amount paid out in dividends, £5.8 million, approximately equalled the amount subscribed for its shares, £6 million.

^{15/} For further details see CUNNINGHAM op. cit., pages 101-102.

Table 3.1 London Price of Electrolytic Copper Wirebars 1920-1969

(£ per long ton)

<u>Year</u>	<u>Average</u>	<u>Year</u>	<u>Average</u>
1920	110	1947	131
1921	75	1948	134
1922	69	1949	133
1923	73	1950	179
1924	68	1951	220
1925	67	1952	259
1926	66	1953 ^{c/}	269
1927	62	1953 ^{d/}	233
1928	69	1954	249
1929	85	1955	351
1930	62	1956	329
1931	42	1957	219
1932	36	1958	197
1933	37	1959	238
1934	34	1960	246
1935	36	1961	230
1936	43	1962	234
1937	60	1963	234
1938	46	1964	351
1939 ^{a/}	49	1965	468
1939 ^{b/}	51	1966	555
1940-	62	1967	418
1945	62	1968	525
1946	77	1969	621

a/ January to August

b/ September to December.

c/ January to July.

d/ August (re-opening of London Metal Exchange) to December 31.

Source: Metallgesellschaft Aktiengesellschaft Metal Statistics, Frankfurt and Main and World Bureau of Metal Statistics.

3.4 The post-war development of the industry

In 1949, sterling was devalued, increasing the attractiveness of copper, and, late in 1952, the Government of Northern Rhodesia enacted a liberal taxation code to encourage new mines. The companies then came into their own and enjoyed years of unparalleled prosperity that enabled them to open up new mines - Bancroft (now Konkola) and Chibuluma which began production in 1956 and 1957 respectively -, to conduct a vigorous campaign of exploration throughout the country, to contribute handsomely to Government revenues and to help finance major projects, in particular the Kariba dam. Table 3.2 shows how the industry's contribution to the country's development, in the form of the taxes it directly paid, rose sharply in the mid-1950s.

In 1957 the copper price fell and the companies again went through a difficult period. The Bancroft mine was closed down. However, by then the major problem facing the industry was increasingly seen to be a political one - how to face up to the eventual coming to power of a black majority government.

The industry did not remain unaffected by the strikes and disturbances which preceded independence in October 1964. However, it was in a reasonably good position to accept the eventual coming to power of an African government. In 1955 it had begun to open the way for African advancement and, although there was still considerable bitterness at the time of Independence in the labour force about past African-European differentials, the industry was still flourishing with a high copper price and was able to afford, at

Table 3.2 The Taxation paid by the Zambian copper mining companies
1954-1969 (Kmn)

1954	30.2 ^{a/}	
1955	28.6	
1956	58.8	
1957	41.7	
1958	21.7	
1959	11.6	14 ^{b/}
1960	24.7	23
1961	30.8	28
1962	27.9	26
1963		25
1964		57
1965		135
1966		163
1967		146
1968		183
1969		237

^{a/} Income Taxation paid by the copper mining companies, customs duties on their imports, and mining, vehicle licences, etc.

^{b/} Contribution of the copper mining industry to the revenue of the Government in Zambia. During the federal years, (until 1963) this included territorial government revenue and that part of federal government revenue spent in Zambia. Excluded from the table is Zambia copper industry revenue paid to federal and territorial governments in Malawi and Rhodesia (1961 K26 million, 1962 K25 million, 1963 K24 million).

Source: Northern Rhodesia Chamber of Mines Year Book 1962 Kitwe 1963, Table 4, page 23 and Mindeco Mining Year Book of Zambia 1972, Kitwe 1973?, Table 2, page 20.

least at that time, the 22% increase in local wage rates decreed by the Brown Commission in 1966. ^{16/} In 1969, the year of nationalization, the taxes it paid to the Government were at a record level of K237 million, compared to K163 million in 1966. ^{17/} Moreover, the years after the Brown award were ones of industrial peace in the copper mines.

3.5 Summary

From this brief survey of the history up to the time of nationalization, several facts stand out. The first is that the copper industry did not slowly emerge in a vibrant economy - it was responsible for the development of the country. A good measure of this, especially for the early days, is the size of the European population. Between 1911 and 1918 this increased from 1,500 to 2,400, and from then to 1931, when copper production started, to 14,000. ^{18/} In 1963, it stood at 76,000. ^{19/}

^{16/} Republic of Zambia. Report of the Commission of Inquiry into the mining industry 1966 (under the Chairmanship of Mr. Roland Brown) Lusaka 1966, page 45-46. Whether the country could afford such an increase in the mining industry's wage scales, which would be used to justify wage increases elsewhere, is a separate matter.

^{17/} In 1969, however, the copper industry contributed 59% of Government revenue as against 71% in 1965 and 64% in 1966. This reflects the fact that other sources of government revenue grew more quickly than did those from the mining industry.

^{18/} Colonial Office Northern Rhodesia 1957 The Government Printer, Lusaka, 1958 Appendix I, Table II, page 109.

^{19/} Republic of Zambia First National Development Plan, 1966-1970 Office of National Development and Planning, July 1966, page 184. The European population decreased sharply after Independence.

The second is that the copper industry of Zambia was, right from the beginning, run by large companies backed by multinational corporations. Without the intervention of the latter it is doubtful whether the industry would have been developed in the late 1920s and have survived the Depression. Moreover, without the backing of large corporations, it is also doubtful whether a mine like Bancroft that was not profitable in its early years would have remained in operation.

These large corporations set up an industry which, again right from the beginning, played a very important role in the world copper industry. As Table 3.3 shows, in 1935 the industry already accounted for 10 per cent of total world primary copper production, about the same percentage as it was to have in 1970 and higher than it had in 1980 (or even in 1982). An early example of the industry's global importance is that the refusal of Zambian producers, and particularly Roan Antelope, to agree to the quotas that other world producers wanted to impose upon them led to the break-up in December 1932 of the New York Conference of Copper Producers and the end of the cartel, Copper Exporters Inc., that had dominated the market since 1926.^{20/} It was only in October 1931 that Roan Antelope's smelter had produced its first copper.

Finally, the development of the copper industry in Zambia was very much the history of free enterprise. The Government did not supply the funds or the impetus to examine the country for minerals or the capital to develop the deposits found. The companies could not escape some involvement in the

^{20/} The Economist December 17, 1932, New York Times and ELLIOTT W. Y. et al International Control in the Non-Ferrous Metals, New York, the Macmillan Company, 1937, pages 466-475.



Table 3.3 Zambian Copper Production 1925-1980, Selected Years
OOO tonnes

<u>Zambian production</u>		<u>World production</u>	<u>Zambian/World production (per cent)</u>
1925	1	1410	—
1930	6	1596	0.4
1935	146	1467	10.0
1940	267	2397	11.1
1945	197	2172	9.0
1950	281	2525	11.1
1955	359	3112	11.5
1960	576	4242	13.6
1965	696	4963	14.0
1970	684	6381	10.7
1975	677	7317	9.3
1980	596	7864	7.6

Source: The Economist, November 2nd 1935, August 22nd 1942, August 2nd 1947, Metallgesellschaft Aktiengesellschaft Metal Statistics.

political processes of the country but they were very much private enterprise organizations, with their own traditions and loyalties, and quite separate from the ruling party, UNIP (United National Independence Party) and without a close affinity with the Government bureaucracy. Part of this independence from government was, no doubt, due to the fact that they were companies owned by non-Zambians with their senior management and most of the skilled positions in the hands of Britons, Americans or South Africans. Nationalization was, then, not a natural progression for the industry but would represent a quite distinct break with the past.

Chapter 4

COPPER AND THE ZAMBIAN ECONOMY

4.1 Zambia's position in the world copper industry

Zambia is one of the world's leading producers of copper as shown in Table 4.1 which gives recent figures for the production of copper in terms of the recoverable copper content of the ores and concentrates produced by the major producers. It will be seen that whereas Zambia was the world's third largest producer of copper in 1969, surpassed only by the United States of America and the Soviet Union, in 1983 it was the fifth largest producer surpassed by these two countries as well as by Canada and Chile.

Zambia has maintained its position as the world's second largest producer of cobalt after Zaire. World production in 1982 was 30,075 tonnes of which Zaire produced 15,400 tonnes and Zambia 4,500 tonnes ^{1/}. Cobalt is essentially a by-product of copper in Zambia and the value of its production much lower than that of copper - in 1979 and 1980 the gross value of cobalt sales came to K130 million and K69.5 million respectively as compared to K980 million and K1068.5 million for copper. ^{2/} The Zambian mining industry is, then, essentially, the copper industry.

While Zambia is only the world's fifth largest producer of copper, accounting for 6.3 per cent of production in 1983, its real importance lies in its being a major exporter of copper as shown in Table 4.2. In 1983 its exports of refined copper totalled 571 thousand tonnes, equivalent to 19 per cent of the total world's exports of this form of copper. Zambia is different

^{1/} Commodity Research Bureau Inc. 1983 Commodity Year Book New Jersey 1983, page 87. Figures on cobalt production differ among sources.

^{2/} Zambia Mining Year Book 1980, Kitwe 1981?, pages 23 and 30.

Table 4.1

World Mine Production of Copper

(000 tonnes)

	1969	1973	1975	1979	1980	1981	1982	1983
United States of America	1,401	1,558	1,282	1,444	1,181	1,538	1,140	1,038
Union of Soviet Socialist Republic	875	1,060	1,100	1,130	1,130	1,140	1,150	1,180
Zambia	720	707	677	588	596	587	530	515
Chile	688	735	828	1,063	1,068	1,081	1,242	1,257
Canada	520	824	734	636	716	691	613	625
Zaire	365	489	495	400	460	505	503	502
Peru	199	203	181	397	367	328	356	322
Philippines	131	221	226	298	305	302	292	271
Australia	131	220	219	238	244	231	245	265
South Africa	127	176	179	203	212	211	207	212
Japan	120	91	85	59	53	52	51	46
China and other Asia	110	140	155	175	177	182	187	185
Yugoslavia	91	112	115	111	117	111	119	130
Poland	48	152	230	340	343	295	376	402
Mexico	66	80	78	107	175	231	239	206
Papua New Guinea	--	183	173	171	147	165	170	183
Others	357	343	552	567	573	655	768	854
Total	5,949	7,502	7,345	7,927	7,864	8,305	8,188	8,193

Source: World Bureau of Metal Statistics World Metal Statistics. The figures show the recoverable copper content of the ores and concentrates produced.

Table 4.2

Major World Exporters and Importers of Copper
(000 tonnes)

	<u>1971</u>	<u>1975</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>
<u>Net Exporters of Copper</u>								
Zambia	629	635	576	647	617	556	603	571
Chile	684	788	978	1,010	1,045	1,038	1,208	1,240
Zaire	406	493	440	366	461	463	515	486
Peru	188	623	509	477	352	322	340	296
Canada	469	623	509	477	608	515	457	588
Papua New Guinea	-	170	195	172	142	168	173	183
Philippines	197	210	258	292	301	295	280	212
South Africa and Namibia	122	155	179	181	160	152	164	188
Australia	91	150	102	124	124	117	116	160
Others	125	176	167	163	263	334	331	...
Total	2,911	3,550	3,760	3,815	4,073	3,960	4,187	...
<u>Net Importers</u>								
Japan	719	916	1,047	1,146	922	1,184	1,309	915
Germany, Federal Republic	471	555	535	526	547	505	564	505
United Kingdom	371	436	394	355	313	258	306	268
France	308	371	282	344	415	387	381	329
Italy	260	282	356	345	375	318	320	300
Belgium	127	164	252	215	202	192	173	106
United States of America	113	114	402	191	405	268	273	542
Brazil	70	126	157	190	208	153	205	56
Others	320	307	461	494	562	484	540	...
Total	2,579	3,271	3,886	3,806	3,949	3,749	4,071	...

Source: World Bureau of Metal Statistics World Metal Statistics. The figures give the net exports (i.e. total of exports of ores and concentrates, measured by their copper content, blister and refined copper less imports) or net imports of the net exporters or importers of copper, and so the totals are smaller than those for total world exports and imports.

from some other developing countries in that it exports nearly all of its copper as electrolytic or blister copper. There are advantages for a developing country in refining or smelting its copper, in the form of the value added it captures. However, world trade in ores concentrates has recently been increasing because of the demand of Japan and also of the Federal Republic of Germany for inputs for their smelters and refineries. Their two countries absorbed, in 1983, 62 and 10 per cent respectively of world imports of this material. Japan had offered to finance the development of new mines in return for long-term contracts to supply its smelters. ^{3/} In 1983, 53 per cent of Japan's supplies came from Canada, the Philippines and Papua New Guinea, the last two being unique in, until 1983, only exporting ores and concentrates and the last country being a new entrant whose development was assisted by Japanese finance. ^{4/} However, because of its position in the middle of Africa connected to the coast by railroads with a limited capacity, transport costs dictate that processing be taken in Zambia at least as far as the blister copper stage. Any new green-field mining development would have to include processing facilities.

4.2 The contribution of the copper industry to the Zambian economy

4.2.1 The overall contribution

While the Zambian copper industry is very important for the world copper industry, it is absolutely essential to the Zambian economy. As Table 4.3 shows, in the period 1960 to 1969, the contribution the industry made to gross domestic product was between 40 and 50 per cent and to Government revenue over 50 per cent, if allowance is made for the diversion of revenue from the Zambian copper industry to the other countries of the Central African Federation in the early years.

^{3/} United Nations Industrial Development Organization Copper Production in Developing Countries (Sales No. E.72.II.B.13), New York, 1972, page 11.

^{4/} MIKESELL R., Foreign Investment in Copper Mining (Baltimore, Johns Hopkins Press, 1975), pages 17, 89, 90.

Table 4.3

Contribution of the Copper Industry to Gross Domestic Product and
Government Revenue
(K million)

	Gross Domestic Product	Contribution of Mining Industry	Percentage (%)	Government Revenue	Contribution of Mining Industry	Percentage %
1960 ^{a/b/}	390	196	50	63 (84)	23 (44)	37 (52)
1961 ^{a/b/}	375	177	47	75 (101)	28 (54)	38 (54)
1962 ^{a/b/}	369	171	46	75 (100)	26 (51)	34 (51)
1963 ^{a/b/}	387	173	45	72 (96)	25 (49)	34 (51)
1964 ^{a/}	457	215	47	108	57	53
1965 ^{a/}	576	246	43	189	134	71
1965	711	290	41	"	"	"
1966	848	379	45	255	163	64
1967	957	379	40	276	146	53
1968	1062	411	39	301	176	58
1969	1316	637	48	400	235	59
1970	1217	457	38	432	251	58
1971	1188	268	23	309	114	37
1972	1348	317	24	315	56	18
1973	1591	506	32	385	108	28
1974	1893	607	32	647	341	53
1975	1583	204	13	448	59	13
1976	1872	330	18	443	12	3
1977	1951	223	11	499	-1	-0.2
1978	2203	272	12	550	-	-
1979	2597	456	18	595	-10	-1.5
1980	2986	468	16	767	42	5
1981	2990	210	7	812	11	1.4
1982	3564	382	11	840	-	-
1983	4206	639	15	957	42	4

Source: Zambia Mining Year Book: Republic of Zambia, Monthly Digest of Statistics, various issues.

a/ Figures for net domestic product at factor cost, including subsistence output and mineral royalty.

b/ From 1960 to 1963 the figures for Zambian revenue include territorial government revenue and that part of federal government revenue spent in Zambia. In brackets are given these figures plus the revenue from the Zambian copper industry paid to federal and territorial governments in Malawi and Rhodesia.

The contribution of the copper industry to domestic exports is normally in the region of over 90 per cent, and to paid employment about 15 per cent. These contributions have changed little over time, for Zambia has not developed any other substantial export lines, nor has the contribution of the mining industry to total employment varied substantially. However, as Table 4.3 shows, the industry's contribution to gross domestic production has been on the decline since 1969, whilst its contribution to government revenue has shown large year to year swings since 1970 and, since 1974, has declined, substantially, being negative in 1977 and 1979. The table shows that these declines were caused by an actual decline in the nominal value of the mining industry's contribution. Whereas in 1974 the industry contributed K607 million to gross domestic product and K341 million to government revenue, in 1982 its contributions had declined to K382 million and nothing, respectively. In 1983, the preliminary figures indicate an improvement in the industry's performance.

4.2.2 The fall in profitability and the increase in indebtedness

The reason for the decline in the contribution to Government revenue was the erosion in the profit positions and therefore in the taxable income of the copper companies. Table 4.4 shows how the pre-tax profits of the two copper groups declined from nearly K500 million in 1973/74 to a deficit of about K60 million in 1975/76 and how very substantial losses were incurred by Zambia Consolidated Copper Mines in 1981/82 and 1982/83.

The drop in profitability and in Government revenue would have been serious enough but in the case of Zambia it was aggravated by the rising foreign indebtedness of the country. As Table 4.5 shows, foreign debt was at a low level at Independence, rose rapidly between 1969 and 1970 and after 1974

Table 4.4

Trend in pre-tax profits for Roan Selection Trust/Roan Consolidated Mines and
Zambian Anglo American/Nchanga Consolidated Copper Mines Ltd.
(K mn)

	<u>Roan Selection Trust/a/ Roan Consolidated Mines</u>	<u>Nchanga Consolidated Copper Mines Ltd.b/</u>	<u>Total</u>
1960	35.5	81.2	116.7
1961	25.0	74.7	99.7
1962	24.7	74.3	99.0
1963	26.6	60.9	87.5
1964	34.8	63.1	97.9
1965	42.4	66.0	108.4
1966	51.0	69.7	120.7
1967	48.5	59.3	107.8
1968	80.4	83.0	163.4
1969	105.6	94.7	200.3
1970	108.7 _{c/}		
1971	85.8	203.7 _{d/}	289.5
1972	53.7	100.4	154.1
1973	75.7	99.9	175.6
1974	222.5	276.5	499.0
1975	42.2	136.8	179.0
1976	-9.4	-49.4	-58.8
1977	21.3	83.6	104.9
1978	-13.2	-37.1 _{e/}	50.3
1979	63.9 _{f/}	26.0	89.9
1980	101.7 _{g/}	131.2	232.9
1981	20.7	13.6	34.3
1982	..	..	-142.8 _{h/}
1983	..	..	-123.0
1984	..	..	96.9

Source: Roan Antelope Copper Mines Ltd. Annual Report, Roan Selection Trust Ltd. Annual Report, Nchanga Consolidated Copper Mines Ltd. Annual Report, Bancroft Copper Mines Ltd. Annual Report, Zambia Consolidated Copper Mines Ltd. Annual Report 1982, 1983, 1984.

a/ The results of Roan Antelope are included in the 1960 and 1961 figures for Roan Selection Trust. Years ending June 30, except 1981 when year ended 31st March.

b/ Rhokana, Nchanga and Bancroft companies only before 1969. Years ending March 31st except Bancroft from 1960 to 1964 and Rhokana from 1960 to 1969 when years ended June 30th.

c/ Six months only.

d/ 15 months ended March 31st.

e/ Under a new accounting method. The comparable figure under the previous system was K-33.6 mn.

f/ Under the new accounting method. The comparable figure under the previous system was K 74.5 mn.

g/ Nine months ended 31st March.

h/ Under a new accounting method. The comparable figure under the previous system was -K 186 million.

Table 4.5

External public debt position of Zambia
(\$ million)

	Debt outstanding at end of year (disbursed only)	Official creditors	Private creditors	Service payments	Service payments as per cent of exports
1965	156.0	93.4	62.6	14.0	2.6
1966	154.6	93.4	61.2	13.9	2.0
1967 ^{a/}	157.0	93.4	63.6	15.9	2.4
1967 ^{a/}	195.2	98.8	96.4	15.8	2.4
1968	209.8	97.6	112.2	20.7	2.7
1969	246.6	104.5	142.1	27.0	3.5
1970	547.9	119.0	428.9	54.4	5.1
1971	534.6	147.9	386.8	71.8	7.2
1972 ^{a/}	559.6	180.1	379.5	85.3	10.3
1972 ^{a/}	676.3	180.8	495.5	112.5	13.6
1973	703.7	275.6	428.1	368.6 ^{b/}	30.6
1974	807.4	422.7	384.7	114.4	7.7
1975	1155.7	555.5	600.2	96.9	11.0
1976	1298.9	691.6	607.3	121.8	10.9
1977	1406.5	791.4	615.1	196.3	20.2
1978	1463.6	935.1	528.5	241.5	25.4
1979	1823.1	1253.8	569.3	256.3	16.7
1980	2187.9	1550.1	637.8	292.3	18.2
1981	2244.5	1637.8	606.7	282.3	24.4
1982	2394.0	1736.6	657.3	177.2	16.3
1983	2638.0	2034.0	604.0	126.2	12.6

Source: World Bank World Debt Tables. International Monetary Fund
International Financial Statistics, various issues.

^{a/} Break in the series.

^{b/} Because of the Government's decision to prepay the Zimco bonds issued for 51 per cent of the former private mining companies assets, debt service was unusually high in 1973.

as the Government incurred debts largely to make up for the short-fall in revenues from the mining sector. From Independence until 1969, service payments were never as much as 3 per cent of exports but by 1978 they had risen to a maximum of 25 per cent.

4.2.3 Zambia's resort to the International Monetary Fund

In 1978, the foreign debt and repayments situation was so serious for Zambia that it had to come to a Standby Agreement for \$390 million with the International Monetary Fund. At the time in April 1978, arrears on Zambia's payments for imports stood at \$630 million and it was clear that unless a major rescue operation were mounted Zambia would have to default on its foreign debt.^{5/} The Fund saw an intimate connection between the foreign debt position and the borrowing that the copper companies had had to undertake in order to maintain and even expand operations. Its reasoning is that even if the copper companies resorted to domestic rather than foreign borrowings, they would be pre-empting savings desired by other groups, including the Government, and thereby putting pressure on them to borrow from overseas. For these reasons, the Fund insisted that the Government agree to impose restrictions on the local borrowings of the mining industry as a condition for its obtaining the \$390 million Standby Agreement. Similarly, the International Monetary Fund imposed a ceiling on mining company borrowings from banks as one of the conditions for its coming to a further agreement - an external arrangement - with Zambia in May 1981.^{6/} In addition, though, specific targets were set for mineral and agricultural production, reduction of budget deficits, balance of payments performance and reduction of payments arrears.^{7/}

^{5/} Economist Intelligence Unit Zambia: Quarterly Economic Review (4th quarter 1978): 5.

^{6/} Ibid., I: 1982, page 5, IMF Survey, May 18, 1981, page 157.

^{7/} Mining Journal, October 7th 1983, page 254.

Another standby facility was negotiated with the International Monetary Fund in March 1983. One of the conditions was again that Zambia Consolidated Copper Mines had to observe a restriction on its direct borrowings from the Bank of Zambia. ^{8/} Another of the conditions was that the Kwacha be devalued by 20 per cent against the SDR. This was along the lines of the 1978 package which also involved a devaluation of the Kwacha by 10 per cent as well as other measures. In July 1984, another standby agreement, for SDR 225 million over the period to April 1986 was agreed to by the IMF. At that time, Zambia's obligations to the IMF, excluding Trust Fund, totalled SDR 664.5 million. ^{9/}

The measures that the Government of Zambia has had to take to obtain the IMF's support have been painful. The 1978 package, for instance, involved the Government's undertaking to cut its budget deficit by cutting expenditures, including those on education and health projects, implementing a prices and incomes policy and taking steps to restore the financial viability of the copper companies. ^{10/} The effectiveness of devaluation is limited in the Zambian context by the fact that Zambia is largely a price-taker for its major export, copper, and that, at least over the short period, many imports such as industrial raw materials and machinery spare parts have a very inelastic demand.

^{8/} Zambia Consolidated Copper Mines 1983 Annual Report, page 5.

^{9/} IMF Survey, August 6, 1984, page 235.

^{10/} New York Times, June 21st 1978, page 23 and IMF Survey, May 8th 1978, page 142.

It would be over-optimistic to think that all Zambia's problems would disappear with a revival of the world copper market leading to higher earnings from copper and therefore greater profits and government revenue. For instance, the country still has to contend with an unsatisfactory agricultural performance which would almost certainly not be immediately corrected by the injection of sums of money.

4.3 Summary

In this chapter, we have seen that Zambia's shares in world copper production and exports are important, but clearly not enough to give it control over the world copper price.

The Zambian copper industry occupies a dominant position in the Zambian economy, accounting for nearly all of exports and at times as much as nearly 50 per cent of gross domestic production and 70 per cent of government revenue. However, in recent years these percentage contributions have fallen and the industry's contribution to Government revenues has in some years been negative.

The principal reason for this was the sharp decline in the profitability of the industry since the mid-1970s. In some years, the industry was even running at a loss before taxes became payable. To compensate for the short fall in revenue from the mines, the Government borrowed heavily from overseas, but the country did not earn sufficient foreign exchange to enable it to service its debts and to pay for imports. Arrears mounted and Zambia has had to seek financial assistance from the International Monetary Fund. The Fund has imposed conditions on its loans, some of which concerned the borrowing and production policies of the mines.

Chapter 5

DATA ON THE PERFORMANCE OF THE ZAMBIAN COPPER MINING INDUSTRY

In this chapter we will primarily be giving tables to illustrate the performance of the Zambian Copper Mining Industry in the periods before and after nationalization. Our figures will cover the period 1960 to 1981, when possible. They will include, then, 10 years before nationalization, 1960 to 1969, and twelve years after. By choosing 1960 as the opening date we are allowing our data to cover a 22 year period which should be sufficient to make meaningful comparisons. The year 1981 was about the last one we could have used for our study. In the following year, the two mining companies were merged into one company, making comparisons more difficult. Although 1981 is really our cut-off point, we will sometimes extend the data to the latest available year, simply for the sake of comparison.

We decided to set out the data in a full chapter so as to be able to explain fully in the text any discrepancies or breaks, and not just allow them to be relegated to footnotes. In this chapter, then, no attempt will be made to draw conclusions from the data.

There are two problems with the data for the period 1960-1981. The first is that, until the end of 1963, Zambia was part of the Central African Federation. This makes it difficult to separate out many of the macro-economic statistics such as trade, and government revenues. The second problem is that the nationalization of the industry involved a re-organization of the corporate structure so that there is no strict continuity between the pre- and post- 1969 companies.

5.1 Comparing the Pre- and Post-nationalization companies

As we saw in chapter 3, from the start of large scale mining operations in Zambia the mines were operated by two groups.^{1/} By 1969, the parent company of one group, Zambian (until 1964, Rhodesian) Anglo American Ltd., and its subsidiaries had interests of 53.7 per cent in Rhokana Corporation, 57.1 per cent in Nchanga Consolidated Copper Mines Ltd., 99.4 per cent in Bancroft Mines Ltd., and 34.4 per cent in Mufulira Mines Ltd.^{2/} Rhokana operated the Nkana mine, Nchanga the Nchanga mines and Bancroft what is now known as the Konkola mine. The Nchanga and Rhokana companies had a 50% interest in Rhokana Copper Refineries that treated the Zambian Anglo American group's output.

The parent company of the other group, Roan Selection Trust Ltd., had a 100 per cent interest in the Luanshya mine, having absorbed Roan Antelope Copper Mines Ltd. in 1962, and a 65 per cent interest in the Mufulira Company which operated the Mufulira, Chibuluma and Chambishi mines. In addition, the Trust controlled the Ndola Copper Refinery, the Baluba deposit, which was on the point of being developed as an extension of Luanshya, a small mine called Kalengwa which had also just begun production in 1969, and several exploration companies. All the above-mentioned companies were registered in Zambia.

In 1969, the output of Zambian Anglo American's mines amounted to 393 thousand tonnes and that of Roan Selection Trust's to 361 thousand tonnes (see Table 5.1). These groups also produced cobalt from their copper mines and the Zambian Anglo American group produced lead and zinc elsewhere, at Broken Hill (Kabwe). Together, they accounted for almost all of the country's mineral

^{1/} For a more detailed account of the pre-1969 corporate relationships see FABER M.L.O. and Potter J.G. Towards Economic Independence Cambridge, Cambridge University Press 1971, and BOSTOCK M. and HARVEY C. Economic Independence and Zambian Copper New York, Praeger 1972.

^{2/} Zambian Anglo American Ltd. Annual Report 1970 page 11.

Table 5.1

Production of Copper from the Two Mining Groups in 1969
(tonnes)

Company	Ore hoisted	Grade milled		Copper Produced
		Percentage copper	Percentage cobalt	
Roan Selection Trust				
Luanshya	6,355,000	1.82	-	116,820
Mufulira	7,605,000	2.50	-	188,560
Chambishi	1,297,000	2.33	-	26,584
Chibuluma	634,000	4.31	0.18	29,315
Total	15,891,000	2.29		361,279
Zambian Anglo American				
Konkola	1,752,000	3.37	-	50,361
Nchanga	9,418,000	3.69	-	242,442
Nkana	5,458,000	1.97	0.12	100,122
Total	16,628,000	3.09		392,925
Total Copperbelt Production				
	32,519,000	2.70		754,205

Source: RST and Anglo American Corporation Mining Year Book of Zambia 1969 and
Mindeco Mining Year Book of Zambia 1970.

Note: The figures exclude Kalengwa which only started production on July 1st
1969. It produced 1,264 tonnes of copper in 1969.

production. Their other interests in the Zambian economy were very small compared to their interests in mining. Also, they had ancillary companies such as the Ametalco group of companies, 100 per cent owned by Roan Selection Trust.

The mines of the Zambian Anglo American group were operated, as were other properties controlled by the Anglo American Corporation of South Africa, by personnel drawn from within the group. On the other hand, the mines of Roan Selection Trust were not operated by its largest shareholder, American Metal Climax, now Amax, of New York, although this company did supply directors and often technical staff. The two groups were linked, most importantly, as we have seen, through the Zambian Anglo American group having a one-third interest in all the operating mines, except Luanshya, belonging to the Roan Selection Trust group. They frequently co-operated on projects of common concern, jointly forming, for instance, the Rhodesia Congo Border Power Corporation in 1949 to co-ordinate and expand the power supplies for their mines. ^{3/} Moreover, they frequently treated each other's ores or concentrates for a fee.

In other respects they were, though, independent groups, and so when reference is made to their "controlling interests" it is to the Anglo American Corporation and its associated companies, backed predominantly by South African and British capital, over the Zambian Anglo American group and to Amax Inc., backed predominantly by American and British capital, over the Roan Selection Trust group. By 1969, Amax's interest in Roan Selection Trust was

^{3/} PRAIN, SIR RONALD Reflections on an Era London, Metal Bulletin Books 1981, pages 92-93.

42.3 per cent. The interest of the Anglo American Corporation in the various companies of the Zambian Anglo American group was considerably more complicated and was not publicly available. It was however about 50 per cent ^{4/} and gave the corporation a clear controlling interest

The Zambian Government took an interest in the producing mines and treatment plant and not in the parent companies. It reorganized the mines of the Roan Selection Trust group into a new company called Roan Consolidated Mines and those of the Zambian Anglo American group into Nchanga Consolidated Copper Mines Ltd. In both companies, its interest initially was 51 per cent and the scheme became effective on 1st January 1970. In May 1981, the Government decided to merge the two companies and in March 1982 the High Court of Zambia approved the merger. The new company is called Zambia Consolidated Copper Mines Ltd.

A year after the 1969 take-over, Roan Selection Trust Ltd. was acquired by and became a wholly owned subsidiary of Amax. It is no longer, then, an independent company. On the other hand, Zambian Anglo American was re-incorporated in Bermuda in 1970 and its name changed to Minerals and Resources Corporation (Minorco) in August 1974. It has 50 per cent of Zambia Copper Investments Ltd., which holds the Anglo American Corporation's Zambian investments, but it is now essentially the Corporation's vehicle for spreading its activities outside Africa into the United States, South America and Australia. In 1982, Minorco decided to provide for a possible permanent diminution of its Zambian holding because of the inability to externalize dividends from there. Minorco's Zambian holdings were in any case a small percentage by then of capital employed, North America and Europe accounting for 77 per cent of business.^{5/} Similarly Amax decided in 1977 to write down

^{4/} FABER AND POTTER op. cit. page 25 and BOSTOCK AND HARVEY op. cit. Pages 259-560.

^{5/} Mining Journal March 6th 1981, pages 182-183, October 1st 1982, page 240, November 19th 1982, page 367.

its investment in Roan Consolidated Mines to a nominal sum. ^{6/} In 1982, the interests of Zambia Copper Investments and of Amax in Zambia Consolidated Copper Mines Ltd. were respectively 27.3 per cent and 6.9 per cent; that of the Zambian Government was 60.3 per cent and of public investors 5.5 per cent. ^{7/} In July 1984, Amax sold its holding in Zambia Consolidated Copper Mines to ITM International, a private trading group. ^{7a/}.

From the above description, it can be seen that the comparison will be essentially between Roan Consolidated Mines and the mines and treatment plant operated by the Roan Selection Trust group and Nchanga Consolidated Copper Mines Ltd. and the mines and treatment plant operated by the Zambian Anglo American group.

5.2 Figures on Mine Production

5.2.1 Copper production

One of the most important indicators of the industry's performance was the rate of production that it was able to achieve. Table 5.2 gives this rate in terms of tonnes of recoverable copper produced by the mines. Recoverable copper is the amount of copper contained in the ores that were brought to the surface. The performance of the Zambian mines cannot be viewed in isolation and so columns (b) to (d) give the percentage shares of Zambian production in world production and in that of the market economies and of the developing countries. ^{8/} This is to clarify whether changes in Zambian production reflected (a) changes in world copper production as a whole;

^{6/} Mining Annual Review 1978, page 15.

^{7/} Mining Journal February 26th 1982, page 163.

^{7a/} Mining Journal, July 6, 1984, page 15.

^{8/} The United Nations definitions are used throughout. Cuba is classified as a developing country and Romania as a centrally planned economy.

Table 5.2

Trends in Zambian Mine Production 1960-1983

(in thousand tonnes of recoverable copper)

	(a)	(b)	(c)	(d)	(e)
Year	Zambian production	Zambia/World (percentage)	Zambia/Market economy ^{a/} (percentage)	Zambia/ Developing countries ^{b/} (percentage)	Zambian Production of cobalt (tonnes)
1960	576.4	13.6	15.9	30.4	0.976
1961	574.7	13.1	15.5	30.1	0.689
1962	562.3	12.3	14.7	29.2	0.727
1963	588.1	12.7	15.2	29.5	0.682
1964	632.3	13.2	15.8	30.7	1.362
1965	695.7	14.0	16.8	32.9	1.544
1966	623.4	11.9	14.4	29.0	1.515
1967	663.0	13.1	16.3	28.6	1.455
1968	684.9	12.5	15.5	29.8	1.197
1969	719.5	12.1	14.9	29.8	1.073
1970	684.1	10.7	13.2	27.8	2.052
1971	651.4	10.1	12.7	26.0	2.079
1972	717.1	10.2	12.7	25.6	2.055
1973	706.6	9.4	11.7	23.6	1.929
1974	698.0	9.1	11.3	21.8	1.964
1975	676.9	9.3	11.9	22.4	1.843
1976	708.9	9.0	11.5	21.5	1.620
1977	656.0	8.3	10.5	18.9	1.703
1978	643.0	8.2	10.5	18.9	1.560
1979	588.3	7.4	9.6	17.4	3.271
1980	595.8	7.6	9.9	17.2	3.309
1981	587.4	7.0	9.0	16.4	2.569
1982	529.6	6.4	8.5	13.9	2.444
1983	515.2	6.3	8.3	13.6	2.407

Source: World Bureau of Metal Statistics, World Metal Statistics and Metallgesellschaft A.G. Metal Statistics and Republic of Zambia Monthly Digest of Statistics.

Notes: a/ The developed market economies and the developing market countries (including Cuba).

b/ The developing countries, including Cuba, but excluding the socialist countries of South East Asia and China.

(b) changes in the production of the market economies as the centrally planned economies, which are perhaps not guided by developments in the world copper market, increased their production at the expense of countries that were exposed to the rigours of the market; or, finally, (c) changes in the production of the developing countries, because they were seen as inhospitable to private enterprise or bad credit risks and thus did not attract the private direct investment or loans required to develop their copper industries. These three explanations for changes in Zambian production would appear to be the most obvious ones. Another reason for calculating Zambian production as a percentage of world and market production is to take into account the effect of any formal or informal agreements amongst producers to cut production in order to restore stability to the market.

Column (e) gives the production of cobalt, which is found at several Zambian mines - Nchanga, Nkana, Baluba and Chibuluma - and is essentially a by-product of copper.

The country's copper production can also be separated into that coming from each of the two groups. We do this so as to be able to separate out particular problems that affected only one group. The several companies' had different financial years and Table 5.3 simply gives for each calendar year the total of the companies' finished copper production for the financial years ending in the year in question. We have not given a figure for the annual output of the Zambian Anglo American group in 1970. This total is part of the 15 months total for 1971. What is missing is the sum of 9 months production in 1969 from Bancroft and Nchanga and six months production from Rhokana, hardly a meaningful figure. No separate figures are given after 1982 because of the merger of the two companies in that year.

Table 5.3

Production of the two major groups 1960-1984 (tonnes of finished copper)

<u>Year</u>	<u>Zambian Anglo-American/NCCMA^{a/}</u>	<u>Roan Selection Trust/RCM^{b/}</u>	<u>Total^{c/}</u>
1960	338,496	220,542	559,038
1961	348,158	205,285	553,443
1962	352,441	212,535	564,976
1963	322,187	211,643	533,830
1964	354,111 ^{d/}	274,545	628,656
1965	361,752	281,443	643,195
1966	397,052	285,327	682,379
1967	306,717	230,421	537,138
1968	343,975	305,426	649,401
1969	365,860	333,981	699,841
1970	..	342,663	..
1971	494,816 ^{e/}	250,355	..
1972	401,283	242,734	644,017
1973	440,007	278,788	718,795
1974	408,753	281,121	689,874
1975	408,666	288,564	697,230
1976	385,414	280,994	666,408
1977	427,810	261,444	689,254
1978	377,156	270,489	647,645
1979	368,332	255,543	623,875
1980	359,816	177,424 ^{f/}	..
1981	356,541	231,377	587,918
1982	..	..	591,853
1983	..	..	575,518
1984	..	..	551,021

a/ Years ending March 31st, except for Bancroft from 1960 to 1964 and Rhokana from 1960 to 1969 when years ended June 30.

b/ Years ending June 30, except 1981 when year ended March 31st.

c/ Total of results of financial years.

d/ Includes nine months only for Bancroft mine.

e/ Fifteen months to March 31st 1971.

f/ Nine months only.

Source: Roan Selection Trust, Zambian Anglo American, Nchanga Consolidated Copper Mines Ltd., Roan Consolidated Mines Annual Reports, various years.

5.2.2 Ore production

In looking at the economic theory of mining, we saw that a company might be in a position to alter the grade of ore that it mines so as to obtain the same finished copper production from a smaller or larger tonnage of ore. Table 5.4 gives the tonnage of ore mined and the grade of ore passing through the treatment plant, the mill, for the period 1960 to 1980. There is very little difference between the grade of ore mined and that milled. The figures came from the Zambian Mining Yearbooks. It is a pity that this fine statistical source ceased publication after the 1980 edition. This is in line with the Zambian tendency to reveal progressively less information than that made available by the private companies, but is nevertheless regrettable. The 1973 Yearbook gives a grade of 3.54 per cent for the grade of ore milled in 1972 and the 1972 Yearbook gives the same figure for 1972 as well as a grade of 3.73 per cent for copper milled in 1971. However, both figures appear too high and so we have given the figures from the 1971 Yearbook for the grade of ore milled in that year - namely 2.52% and have calculated from the data given for the individual mines the average grade of ore passing through the mill in 1972 - 2.60 per cent. It should be added that these figures were close to those given in the Zambian Monthly Digest of Statistics for the metal content of the copper ores treated^{9/}. We have used the figures for the tonnage of ore treated from the Monthly Digest to extend the series to 1983.

^{9/} Republic of Zambia Monthly Digest of Statistics, Central Statistical Office, Lusaka, Volume XVIII Nos. 1 to 3, January to March 1982, Table 10(a), page 16.

Table 5.4

Ore mined in Zambia 1960-1983

(000 tonnes)

<u>Year</u>	<u>Tonnage mined</u>	<u>Grade of ore milled</u> <u>(%)</u>
1960	22,660	2.98
1961	21,558	3.09
1962	21,256	3.05
1963	22,690	2.94
1964	24,801	2.93
1965	27,942	2.99
1966	25,175	2.55
1967	27,818	2.79
1968	30,860	2.66
1969	32,654	2.70
1970	32,050	2.67
1971	30,726	2.52
1972	33,853	2.60
1973	35,013	2.53
1974	35,954	2.46
1975	34,312	2.65
1976	32,996	2.52
1977	32,698	2.43
1978	31,822	2.44
1979	29,838	2.31
1980	29,997	2.28
1980 ^{a/}	31,169	2.29
1981 ^{a/}	30,325	2.27
1982 ^{a/}	31,909	2.18
1983 ^{a/}	30,532	2.13

^{a/} Tonnage of ore treated.

Source: Zambia/Northern Rhodesia Chamber of Mines Mining Yearbook, various years (until 1980), Republic of Zambia Monthly Digest of Statistics January/March 1984, page 14.

5.3 The Efficiency of operations

5.3.1 Labour productivity

Productivity, as measured by the output of copper or copper ore per employee, can be calculated from the preceding figures for copper and ore production. Output of ore per man is probably the better measure of productivity as output of finished copper per head would not bring out the effect of falling ore grades. Table 5.5 gives these figures, both for the output per employee and per local employee. Table 5.6 gives the establishment figures for the Zambian copper mines, divided into local and expatriate employees, that were used in the calculations, and the ratio of expatriate to local employees.

5.3.2 Technical efficiency of the treatment plant

Not all of the copper contained in the ore extracted from the ground becomes finished copper. Some is lost in the treatment plant. Another indicator of efficiency would then be the recovery rates at the treatment plants which are given in Tables 5.7 and 5.8. These show the percentage of contained copper recovered at the concentrator stage, the stage where the greatest losses occur. Recovery rates are difficult to interpret because a change could simply be caused by changes in the ores being mined, from a more to a less tractable ore, for example.

Table 5.5

Productivity at the Zambian mines

(tonnes per year)

<u>Year</u>	<u>Ore mined per employee</u>	<u>Ore mined per local employee</u>	<u>Copper produced per employee</u>	<u>Copper produced per local employee</u>
1960	511	616	13.0	15.7
1961	462	552	12.3	14.7
1962	468	564	12.4	14.9
1963	508	614	13.2	15.9
1964	544	651	13.9	16.6
1965	598	704	14.9	17.5
1966	525	600	13.0	14.9
1967	569	639	13.6	15.2
1968	642	714	14.3	15.9
1969	677	751	14.9	16.5
1970	661	727	14.1	15.5
1971 ^{a/}	618	683	13.1	14.5
1972	666	732	14.1	15.5
1973	663	725	13.4	14.6
1974	641	695	12.4	13.5
1975	597	647	11.8	12.8
1976	577	622	12.4	13.4
1977	554	590	11.1	11.8
1978	561	596	11.3	12.0
1979	537	565	10.6	11.1
1980	519	543	10.3	10.8
1981 ^{a/}	499	521	9.7	10.1
1982	543	567	9.0	9.4
1983	529	549	8.9	9.3

Source: As for tables 5.2, 5.4 and 5.6.

^{a/} After 1971 includes the Centralized Services Divisions of NCCM and RCM.

^{b/} Break in series. The labour figure is calculated from Zambia Consolidated Copper Mines Ltd.

Table 5.5

Productivity at the Zambian mines

(tonnes per year)

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1968	642	714	14.3	15.9
1969	677	751	14.9	16.5
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1972	666	732	14.1	15.5
1973	663	725	13.4	14.6
1974	641	695	12.4	13.5
1975	597	647	11.8	12.8
1976	577	622	12.4	13.4
1977	554	590	11.1	11.8
1978	561	596	11.3	12.0
1979	537	565	10.6	11.1
1980	519	543	10.3	10.8
1981 ^{a/}	499	521	9.7	10.1
1982	543	567	9.0	9.4
1983	529	549	8.9	9.3

Source: As for tables 5.2, 5.4 and 5.6.

^{a/} After 1971 includes the Centralized Services Divisions of NCCM and RCM.

^{b/} Break in series. The labour figure is calculated from Zambia Consolidated Copper Mines Ltd.

Table 5.6
Labour Strength

<u>Total</u>	<u>Zambian</u>	<u>Expatriate</u>	<u>Ratio of expatriate to local employees</u>
44,334	36,806	7528	20.5
46,677	39,036	7641	19.6
45,461	37,681	7780	20.6
44,624	36,948	7676	20.8
45,552	38,097	7455	19.6
46,712	39,677	7035	17.7
47,932	41,951	5981	14.3
48,891	43,513	5378	12.4
48,043	43,198	4845	11.2
48,227	43,500	4727	10.9
48,469	44,094	4375	9.9
49,748	44,997	4751	10.6
50,845	46,245	4600	9.9
52,792	48,287	4505	9.3
56,128	51,736	4392	8.5
57,487	52,992	4495	8.5
57,142	53,082	4060	7.6
59,055	55,446	3609	6.5
56,682	53,437	3245	6.1
55,525	52,831	2694	5.1
57,743	55,258	2485	4.5
60,078	57,457	2621	4.6
60,259	57,720	2539	4.4
60,803	58,207	2596	4.5
58,795	56,223	2572	4.6
57,676	55,644	2032	3.7
58,104	56,316	1788	3.2

Source: Mining Yearbooks, Roan Consolidated Mines, Nchanga Consolidated Copper Mines Ltd., Zambia Consolidated Mines Ltd., Annual Reports.

a/ After 1971 includes the Centralized Services Division of NCCM and

b/ Figures from Roan Consolidated Mines and Nchanga Consolidated Copper Mines Ltd. Annual Reports.

c/ Figures from Zambia Consolidated Copper Mines Ltd. Annual Reports.

Table 5.7

Recovery at the Concentrators, 1960-1984
Roan Selection Trust/Roan Consolidated Mines:
(Percentage)

<u>Year</u> ^{a/}	<u>Chambishi</u>	<u>Chibuluma</u>	<u>Kalengwa</u>	<u>Luanshya</u>	<u>Mufulira</u>	<u>Baluba</u>	<u>RCM</u>
1960	--	97.61	--	85.61	92.02	--	--
1961	--	96.83	--	87.44	98.98	--	--
1962	--	97.25	--	89.07	91.15	--	--
1963	--	96.86	--	89.57	90.82	--	--
1964	--	96.12	--	90.61	90.52	--	--
1965	--	95.69	--	91.84	91.38	--	--
1966	n.a.	96.53	--	92.03	91.70	--	--
1967	n.a.	n.a.	--	91.36	91.23	--	--
1968	n.a.	n.a.	--	90.57	91.69	--	--
1969	n.a.	n.a.	--	90.72	91.70	--	--
1970	96.14	96.82	--	91.96	91.26	--	--
1971	92.34	96.17	--	90.80	90.71	--	--
1972	90.15	96.51	83.09	90.01	91.08	--	--
1973	90.39	96.55	75.94	89.97	91.71	--	--
1974	87.73	96.39	81.99	87.90	93.28	--	--
1975	72.92	96.15	81.52	89.50	92.65	--	--
1976	91.65	96.78	85.31	89.30	92.67	--	--
1977	74.80	96.52	88.23	90.19	93.30	--	--
1978	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	92.05
1979	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	91.77
1980	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	92.61
1981	93.29	96.53	61.39	95.10	92.52	96.28	93.13
1982	94.60	96.89	62.15	93.65	93.00	92.13	..
1983	94.18	96.36	--	92.00	92.97	89.31	..
1984	94.12	94.55	--	92.15	93.95	93.47	..

Sources: Roan Antelope Copper Mines Ltd., Roan Consolidated Mines, Roan Selection Trust, Zambia Consolidated Copper Mines, Annual Reports.

^{a/} For the financial years as described in Table 5.3.

Table 5.8

Recovery at the Concentrators,
Zamanglo Group/Nchanga Consolidated Copper Mines Ltd. 1960-1984
(Percentage)

Year ^{a/}	<u>Bwana Mkubwa</u>	<u>Konkola</u>	<u>Nchanga</u>	<u>Nkana Underground</u>	<u>Nkana Open Pit</u>	<u>Nkana Torco</u>
1960	--	86.08	88.56	92.13	--	--
1961	--	84.70	87.53	92.29	--	--
1962	--	84.28	88.86	93.58	--	--
1963	--	84.97	90.77	92.88	--	--
1964	--	84.97	92.58	93.52	--	--
1965	--	86.83	92.07	93.61	--	--
1966	--	86.62	90.47	93.55	--	--
1967	--	86.84	88.20	93.91	--	--
1968	--	84.07	87.58	94.14	--	--
1969	--	82.11	83.83	93.17	--	--
1970	--	--	--	92.93 ^{b/}	--	--
1971	--	85.90	83.80	92.63	--	--
1972	72.07	84.27	83.74	92.33	--	--
1973	72.90	87.19	81.56	92.36	--	83.80
1974	78.67	85.57	82.25	94.78	26.75	82.60
1975	77.86	82.59	82.57	94.24	55.95	78.40
1976	--	--	--	--	--	--
1977	81.27	85.52	75.39	92.70	64.73	76.56
1978	76.86	88.61	69.61	92.74	70.32	74.95
1979	82.60	87.45	68.85	91.08	66.48	71.73
1980	78.59	82.68	67.46	90.94	63.78	71.67
1981	77.52	84.65	70.46	92.92	75.26	67.40
1982	77.52	84.42	70.95	92.52	79.20	71.13
1983	70.20	85.93	64.36	91.01	67.88	76.09
1984	70.15	86.77	63.34	92.03	46.05	--

Source: Bancroft Copper Mines, Nchanga Consolidated Copper Mines, Rhokana Corporation, Zambia Consolidated Copper Mines, Annual Reports.

^{a/} For the financial years described in Table 5.3.

^{b/} Last six months of 1969.

5.3.3 The accident rates

The other technical aspect of mining that should be examined is the safety aspect. It could be the case that higher ore production was being achieved at the expense of a relaxation of safety standards. In this connection, it could be pointed out that it has been suggested that one of the reasons why the military government in Poland was able to increase coal production so rapidly after the imposition of martial law was that safety standards at the mines were relaxed.^{18/}

Table 5.9 gives the safety figures as published in the Mining Yearbooks. The first column shows the casualties, excluding fatalities, per 100,000 hours worked. A casualty is defined as an employee who suffered a lost time accident which prevented him from continuing his normal duties beyond the end of the shift in which the accident occurred. The second column shows the shifts lost as a result of non-fatal accidents and the final column the number of fatalities per million hours worked.

5.4 The trend in costs of production

The efficiency of all branches of operations was reflected, in the final outcome, in the costs of production. There is some difficulty in giving a consistent series for the pre- and post- nationalization periods as the way in which the cost figures were set out was changed after 1970. Also, before nationalization, the Zamanglo group only gave the cost of sales for the individual companies and no further break-down.

5.4.1 Costs at the mine

The Roan Selection Trust broke its costs for every producing mine down into costs at the mine, provision for replacements, which together made up costs free on rail (f.o.r.); then transport to an African port, port handling

^{18/} Mining Journal, August 19, 1983, page 126.

Table 5.9

Accident figures for the Copper Mines

<u>Year</u>	<u>Casualties per 100,000 hours worked (excluding fatalities)</u>	<u>Shifts lost per 1000 hours worked</u>	<u>Fatalities per 1,000,000 hours worked</u>
1960	2.89	0.59	0.50
1961	2.70	0.56	0.52
1962	3.08	0.66	0.48
1963	3.42	0.61	0.26
1964	3.46	0.59	0.33
1965	3.29	0.64	0.20
1966	3.65	0.75	0.29
1967	3.31	0.60	0.26
1968	2.82	0.54	0.26
1969	2.69	0.51	0.38
1970	2.02	0.41	0.91 ^{a/}
1971	1.82	0.38	0.36
1972	1.89	0.45	0.18
1973	1.78	0.45	0.28
1974	1.78	0.42	0.22
1975	1.64	0.36	0.27
1976	1.63	0.42	0.21
1977	1.56	0.36	0.20
1978	1.40	0.32	0.21
1979	1.48	0.26	0.15
1980	2.22	0.35	0.22

Source: Zambia Mining Yearbooks, various years.

a/ The Mufulira disaster was in September 1970.

and freight to the final destination and administrative and selling costs. On top of this had to be added mineral royalties and the export tax to arrive at cost delivered buyers. Table 5.10 gives these figures worked out as an average for the group, using final copper production as the weights. Only incomplete figures are given for 1960 as the cost figures prepared for that year had a different breakdown into categories.

Roan Selection Trust also gave figures for the cost of sales which amounted to slightly less in most years than the figures we have given for cost delivered buyers. The reason for this is that we have used production figures rather than sales to weight the cost figures and also have only given the final cost per ton of electrolytic copper, whereas much of the Trust's output was sold as fire refined copper. Also, certain administrative charges are not given in the cost of sales.

After April 1st 1970, the royalty and mineral taxes were discontinued and so the figures from 1971 onwards for the cost of sales should be compared to the cost of sales of the Trust less mineral royalties and export taxes. These figures are given in the last column of the table. We have also given, in Table 5.10, the totals of railage, freight and administrative charges for the Trust's mines and, from 1970 onwards, the simple difference between the cost of sales and the costs free on rail. Although not strictly comparable before as opposed to after 1970, the trend in these costs should give an idea of the trend in these additional costs.

After nationalization, costs f.o.r. were shown in some detail, broken down into mining costs, concentrating costs, leaching, smelting and refining costs, administration, technical services and mine general expenses and, later, depreciation. These figures are given in Table 5.11. There was a discontinuity between 1969/70 and 1970/71 because of the ending of the provision for replacements.

Table 5.10

Roan Selection Trust/Roan Consolidated Mines: Cost Figures electrolytic copper 1960-1981
(K per tonne)

Year ^{a/}	Costs f.o.r. mine	Transport to African port	Handling and freight charges	Admini- stration and selling charges	Sub- Total	Total	Mineral Royalty	Export Tax	Total cost delivered buyers	Cost of sales less royalties and export tax b/	
1960	--	33.0	--	--	--	--	49.4	--	--	334	284
1961	250.1	30.2	10.4	14.6	55.1	305.2	46.3	--	351.5	344	298
1962	241.7	30.8	10.6	14.1	55.5	297.2	46.2	--	343.4	341	294
1963	242.7	33.7	11.3	14.7	59.6	302.2	46.3	--	348.5	335	288
1964	219.3	33.7	11.8	15.8	61.3	280.6	51.5	--	332.1	327	276
1965	228.6	33.9	12.2	17.4	63.5	292.1	87.6	--	379.7	360	279
1966	265.1	37.2	13.3	19.4	69.9	335.1	124.7	34.3	494.1	439	318
1967	329.2	52.0	14.6	28.3	94.8	424.0	95.7	88.6	608.2	616	396
1968	307.8	48.9	14.7	23.0	86.6	394.4	99.4	102.9	596.6	586	387
1969	313.1	48.2	15.6	27.3	91.0	404.2	99.4	105.9	609.5	588	395
1970 (6 months)	339.6				124						464
1971	412				116						528
1972	448				119						567
1973	464				103						567
1974	523				136						659
1975	619				159						778
1976	680				167						847
1977	806				185						991
1978	809				206						1015
1979	868				246						1114
1979 ^{c/}	908				244						1152
1980	1213				325						1538
1981	1380				317						1697

Source: Roan Antelope Copper Mines Ltd., Roan Selection Trust, Roan Consolidated Mines, Annual Reports, various years.

a/ For the financial years described in Table 5.3.

b/ Calculated from the company's profit and loss account, and not from the cost figures for electrolytic copper production.

c/ Costs restated to show the change to a new accounting method for depreciation.

Table 5.11

Roan Selection Trust/Roan Consolidated Mines:Costs at the Mine
(K per tonne)

<u>Mining</u>	<u>Concentra- ting</u>	<u>Smelting and leach plant</u>	<u>Refining</u>	<u>Admini- strative and technical and mine general expenses</u>	<u>Costs excluding deprecia- tion</u>	<u>Replace- ments or Deprecia- tion</u>	<u>Average cost f.o.r. mine</u>
--	--	--	--	--	227.2	22.9	250.1
--	--	--	--	--	220.0	21.8	241.7
--	--	--	--	--	218.9	23.8	242.7
--	--	--	--	--	200.7	18.5	219.3
--	--	--	--	--	209.7	18.9	228.6
--	--	--	--	--	243.8	21.4	265.1
--	--	--	--	--	298.5	30.6	329.2
--	--	--	--	--	283.6	24.1	307.8
155.0	32.1	51.0	24.1	32.9	295.0	18.1	313.1
167.9	32.1	48.3	22.0	43.3	313.6	26.0	339.6
232	47	51	22	60	..	..	412
252	54	64	21	58	..	..	448
262	58	65	21	58	..	..	464
288	60	78	24	73	..	..	523
355	75	88	30	71	..	..	619
403	77	90	32	78	..	..	680
485	85	122	32	82	..	..	806
458	81	118	31	77	765	41	806
457	90	111	30	89	777	32	809
477	100	122	28	105	832	36	868
477	100	122	28	105	832	76	908
609	131	148	30	204	1122	91	1213
760	153	183	40	157	1293	87	1380

e: Roan Selection Trust, Roan Consolidated Mines Annual Reports, various years.

for the financial years described in Table 5.3.

discontinuity because of the end of the provision account for replacements in 1970/71.

Costs without replacements being shown separately.

Costs with replacements being shown separately.

Costs restated to show change to new accounting method for depreciation.

Table 5.11 shows that the order of importance of the different stages of production was the following: mining, smelting, concentrating and refining.

Table 5.12 is the final one covering the costs of production. It shows the costs of each stage in the metal production process in relation to its particular output.

As mining costs are given per tonne of ore hoisted and concentrating costs per tonne of ore milled, they do not take into account changes in ore grades as do the figures for mining and concentrating costs per tonne of copper produced. Smelting and refining costs are shown per tonne of copper produced. These costs are for the three Roan Selection Trust/Roan Consolidated Mines that were operating continually from 1960. No such cost figures were available for the Zamanglo/Nchanga Consolidated Copper Mines' mines, and Roan Consolidated Mines stopped giving these figures after 1977.

These figures outline the trend in costs, particularly before 1969, at the different mines and should be helpful in showing whether trends in overall costs at the group marked significant developments at the individual mines -- for instance whether one mine's approaching exhaustion, and therefore rising production costs, was partly responsible for the adverse cost developments of the group.

5.4.2 The cost of labour

As well as trying to improve the technical efficiency of operations, the mining companies could also attempt to use labour more economically or to keep down wage increases so as to reduce the labour component of production costs.

Table 5.13, which is a modified and up-dated version of that given by Philip Daniel^{19/} shows labour, and also transport, costs in absolute terms and as a proportion of total costs of sales (excluding mineral royalties and

^{19/} DANIEL, P. Africanisation, Nationalisation and Inequality Cambridge, Cambridge University Press 1979, page 85.

Table 5.12

Trend in costs at Luanshya, Mufulira and Chibuluma mines, 1960-1977
(K)

Year ^{a/}	Luanshya		Smelting costs per tonne of new anodes ^{b/}	Mufulira		Refining costs per tonne of copper	Chibuluma		
	Mining costs per tonne of ore	Concentrating costs per tonne of ore		Mining costs per tonne of ore	Concentrating costs per tonne of ore		Mining costs per tonne of ore hoisted	Concentrating costs per tonne of ore	
1960 ^{c/}	1.62	0.31	17.24	2.37	0.63	15.33	15.49	3.63	0.89
1961 ^{c/}	1.73	0.34	21.13	2.22	0.53	18.26	14.98	4.08	0.83
1962	1.93	0.35	20.30	2.17	0.57	15.36	13.60	4.72	0.85
1963	2.17	0.34	22.33	2.62	0.66	18.68	18.04	5.29	0.96
1964	2.29	0.32	24.58	2.04	0.54	18.06	18.46	4.73	0.95
1965	2.45	0.31	27.53	2.25	0.52	16.79	15.89	4.75	0.99
1966	2.82	0.32	29.19	2.71	0.55	20.39	18.32	5.04	1.09
1967	3.21	0.34	39.41	2.90	0.58	34.57	22.49	6.35	1.30
1968	2.85	0.32	40.61	2.71	0.56	41.91	17.37	5.54	1.25
1969	3.11	0.32	44.69	2.87	0.59	45.04	19.52	5.67	1.28
1970	3.31	0.33	44.60	2.98	0.64	41.96	18.03	6.96	1.45
1971	3.72	0.39	48.74	4.77	0.91	47.21	22.30	7.12	1.46
1972	4.19	0.52	48.32	4.34	0.82	64.28	22.13	7.72	1.30
1973	4.76	0.60	57.52	4.24	0.72	64.23	23.27	8.78	1.37
1974	5.00	0.70	63.80	4.34	0.84	74.08	30.41	11.04	1.86
1975	6.62	0.93	85.22	5.17	1.03	72.95	39.77	12.06	2.25
1976	7.47	0.93	97.42	5.91	1.09	71.08	43.26	14.49	2.61
1977	9.33	1.16	109.91	7.10	--	--	--	17.33	2.86

Source: Roan Selection Trust, Roan Consolidated Mines Annual Reports, various years.

a/ For the financial years described in Table 5.3.

b/ The figures for 1960 to 1965 have been adjusted as those for this period were for copper produced from concentrates and those from 1967 for tonne of anode copper produced.

c/ These costs were not strictly comparable with those of subsequent years because of the exclusion of labour overheads

Table 5.13

Cost of Sales^{a/} per tonne divided into labour, transport and other costs
1960-1980

	Labour ^{b/}		Transport ^{c/}		Other		Total
	K	%	K	%	K	%	
1960	93	33	39	14	146	53	278
1961	96	33	42	14	153	53	291
1962	97	33	43	15	152	52	292
1963	97	35	45	16	139	49	281
1964	88	32	46	17	144	52	278
1965	101	34	47	16	151	51	299
1966	130	37	55	16	168	48	253
1967	143	37	62	16	186	48	391
1968	137	35	63	16	191	49	391
1969	110	27	64	16	221	56	395 ^{d/}
1970	137	27	63	13	301	60	500 ^{e/}
1971	161	29	65	12	321	59	547
1972	156 (162)	28	68	12	343	60	567
1973	182 (196)	30	68	11	363	59	613
1974	202 (214)	28	79	11	440	61	721
1975	221 (234)	27	87	11	503	62	811
1976	216	24	86	9	616	67	918
1977	273	27	88	9	642	64	1003
1978	306	28	98	9	682	63	1086
1979	295	23	109	8	901	69	1305
1980	354	22	139	8	1135	70	1628

Source: DANIEL, P. Africanization, Nationalisation and Inequality: Cambridge (Cambridge University Press) 1979, page 85 for the figures 1960-1971. From 1972 onwards, own estimates, using the same Roan Antelope Copper Mines Ltd., Roan Consolidated Mines and Roan Selection Trust Annual Reports, various years, Zambia Mining Yearbook, various years.

^{a/} Costs of sales at the Roan Selection Trust/Roan Consolidated Mines were used. Figures for the calendar year were obtained as the weighted average of the results for the two relevant financial years. The weights were the tonnages of sales. Cost of sales were calculated exclusive of royalty and export tax payments.

^{b/} The figures in brackets are those given by Daniel.

^{c/} Transport costs were calculated f.o.r. mine to c.i.f. United Kingdom and world ports.

^{d/} For six months only to 30th June 1969.

^{e/} Based on the 18 months from 1st January 1970 to 30th June 1971. Total costs per ton were temporarily exaggerated by the Mufulira mine disaster.

export taxes in the period before nationalization). A rising percentage of total costs attributable to labour costs would be an indication that the companies were not able to contain the upward pressure on total costs of labour costs. It is not an unambiguous indicator however as "other costs", which as Table 5.13 indicates normally formed over 50% of costs of sales, could have changed because of factors that were, in the short term, outside the companies' control - such as through an increase in fuel prices. The actual as well as the percentage contribution of labour costs to costs of sales must, therefore, be examined.

The cost of labour was not just a component of the total costs of production but also a very sensitive political and economic issue. The disparities between expatriate and local labour rates led to industrial friction particularly in the early 1960's ^{20/}, and movements in wage rates at the mines have been found to determine wage movements elsewhere in the Zambian economy ^{21/}.

However, the disparity between expatriate and Zambian labour costs did allow the companies room to reduce overall labour costs by displacing expatriates from jobs which had previously been their preserve and replacing them by Zambians. This was particularly the case after March 1966 when the European work force in effect allowed the companies to remove the guarantee of employment, which had been an integral part of the African Advancement agreements of the 1950's, and to replace Europeans by Zambians as soon as the

^{20/} For a fuller treatment vide BURAWOY, M. The Color of Class on the Copper Mines, Zambian Papers No. 7, Manchester University Press 1972 and FRY, James, Employment and Income Distribution in the African Economy, London, Croom Helm, 1979.

^{21/} KNIGHT, J. F. "Wages and Zambia's Economic Development" in ELLIOTT, C. Constraints on the Economic Development of Zambia, Nairobi, Oxford University Press, 1971.

Table 5.14

Average annual earnings in the mining and quarrying industry 1960-1980
(K)

<u>Year</u>	<u>Local Labour</u>	<u>Expatriate Labour</u>	<u>Ratio</u>
1960	570	5 188	9.10
1961	578	5 178	8.96
1962	592	5 126	8.66
1963	596	5 128	8.60
1964	732	5 150	7.04
1965	826	5 378	6.51
1966a/ b/	934	6 598	7.06
1967a/ b/	1 322	7 608	5.75
1968a/ b/	1 248	7 604	6.09
1969a/	1 412	8 174	5.79
1970a/	1 543	7 229	4.69
1970a/	1 480	6 982	4.72
1971a/	1 569	7 336	4.68
1972a/	1 491	6 971	4.68
1972a/ b/ *	1 601	5 014	3.13
1973a/ b/	1 685	5 406	3.21
1974a/ b/	1 701	6 629	3.90
1975b/ c/	1 478	6 784	4.59
1976b/ c/	2 510	10 304	4.11
1977b/ d/	2 344	7 224	3.08
1978b/ e/	2 521	7 940	3.15
1979b/ e/	2 636	6 916	2.62
1980b/ e/	2 935	10 127	3.45

Source: Republic of Zambia Monthly Digest of Statistics, various issues.

a/ Based on 4th quarter only.

b/ Cash earnings only, excluding earnings in kind and employers' contributions to pension funds, and so forth

c/ December

d/ June

e/ Based on second quarter.

* Revised.

Zambians were ready to take over their jobs. ^{22/} Indeed, whereas in 1960, the expatriate wage bill came to 63% of the total wage bill, by 1975 it came to only 39% ^{23/}.

An indication of the disparities between Zambian and expatriate earnings is provided by Table 5.14 which gives the average annual earnings for Zambian and expatriate workers in the mining and quarrying industry (which employed, in June 1980, 62,940 workers, as against 57,743 in the copper mines in 1980). These figures are not then strictly those for the average earnings of the local and expatriate copper miners. Moreover, certain very important costs, especially for the expatriate labour force, were excluded - such as contributions to their pension funds and the many benefits they received such as educational assistance, repatriation and leave allowances. These would have made the ratio of expatriate to local labour costs even higher. It is, through, quite clear from Table 5.14 that expatriate labour costs were considerably higher than local labour costs even before these extras were taken into consideration.

The trend in the ratio of expatriate to local labour costs would appear, from Table 5.14, to have been downward. Not too much can be read into this, though, both because of problems with the data and because of Zambianization. If at the end of Zambianization, only the senior managers at the mines were still expatriates, the ratio of their average salaries to those of the average Zambian mine worker would still have been very high (even if Zambian senior managers had been paid the same as expatriates senior managers).

Zambian wage costs were, though, lower than expatriate wage costs for the same position. Specific examples of this are given by Fry ^{24/}. An

^{22/} Brown Commission: Republic of Zambia. Report of the Commission of Inquiry into the Mining Industry 1966. Under the Chairmanship of Mr. Roland Brown, Lusaka, 1966, pages 19-20.

^{23/} DANIEL, P. op. cit., page 181.

^{24/} FRY. op. cit., page 128.

expatriate mining plant operator at the concentrator was paid K 258.5 a month in 1966. In 1967, when this post had been Zambianized, the Zambian operative earned K 137.3. Similarly the Zambianization of the post of a certified winding engine driver reduced the cost of this post from K 329.7 in 1965 to K 165.5 in 1967. Even in jobs that were partly Zambianized, the Zambian earned less than the expatriate operative. An expatriate mining plant shift boss/foreman earned K 561.8 a month in 1975, whereas his Zambian counterpart earned K 308.7.

The best way to look at the trend in labour costs, particularly with a view to seeing how successful the companies were in moderating their increase, is to look at trends in the wage rates for specific posts performed by local workers. To some extent, the cost of expatriate labour is outside the companies' control as they really have to compete on international markets for expatriates' skills and so have to pay this market's rates. Table 5.15 gives the local wage rates for these jobs. Where two figures are given, this indicates the range of the wage rate for that grade. The surface wage for the unskilled workman and then the rate for the P1 grade in which this post was placed is given in the first column. Beside it, in brackets, is given this rate deflated by the consumer price index for lower income urban workers with 1975 as the base. Next is given, the rate for a surface Operator I and then for the corresponding P5 grade and beside it the deflated figure. The following two columns show the rates given by Fry for P5/rockbreakers, who were underground workers, for the period 1961-1966 and then these rates, similarly deflated. These P5 workers were semi-skilled workers. In the last two columns are given the local wage rates of a skilled worker - from 1964 to 1969 for an artisan foreman and then from 1970 for the corresponding P11 surface workers. These were deflated by the consumer price index for higher income urban workers.

Table 5.15

Local mine workers' wages (surface) nominal and deflated (1975=100) ^{a/} 1961-1981
(K per annum)

	Workman/b/ P1		P5 Operator Surface ^{c/}		P5 Rockbreaker Underground ^{d/}		Artisan Foreman P11 ^{e/}	
1961	28.68	(61.5)	...		46.43	(99.6)	...	
1962	33.38	(70.4)	...		50.81	(107.2)	...	
1963	31.64	(67.5)	...		48.16	(102.7)	...	
1964 (June)	39.13	(80.2)	...		67.80	(138.9)	...	
1965 (April)	39.13	(75.3)	62.20	(119.6)	67.80	(130.4)	199.84	-228.38 (374.9-428.4)
1966 (October)	54.6	(94.0)	91.83	(158.1)	87.43	(150.5)	256.2	-292.8 (459.1-524.7)
1967	54.6	(90.0)	91.83	(151.3)			256.2	-292.8 (433.5-495.4)
1968	54.6	(81.3)	91.83	(136.7)			256.2	-292.8 (400.9-458.2)
1969	54.6	(79.1)	91.83	(133.1)			256.2	-292.8 (381.3-435.7)
1970 (November)	54.5-66.5	(77.0-93.9)	86.5-115	(122.2-162.4)			257-307.5	(364.5-436.2)
1971	54.5-66.5	(72.6-88.5)	86.5-115	(115.2-153.1)			257-307.5	(345.0-412.8)
1972	54.5-66.5	(69.1-84.3)	86.5-115	(109.6-145.8)			257-307.5	(326.6-390.7)
1973 (November)	54.5-79.0	(64.9-94.0)	96.5-136	(114.9-161.9)			291.5-350.0	(344.6-413.7)
1974	54.5-79.0	(60.0-87.0)	96.5-136	(106.3-149.8)			331.5-390	(316.2-379.6)
1975 (August)	64.5-89.0	(64.5-89)	106.5-146	(106.5-146)			351-411	(331.5-390)
1976 (November)	64.5-95.0	(54.7-80.5)	127-162	(106.9-136.4)			363-423.5	(302.3-354)
1977 (November)	68.5-100	(48.1-70.3)	131-168	(92.1-118.1)			375-436	(266.9-311.4)
1978 (November)	68.5-100	(41.4-60.4)	136-174	(82.1-105.1)			395-456	(245.7-285.7)
1979 (August)	78.5-114	(43.2-62.8)	153-191	(84.3-105.2)			404-481	(232.6-268.6)
1980 (August)	84.5-132	(41.6-65.1)	161-213	(79.3-105.0)			429-506	(213.3-254.0)
1981 (August)	102.5-150	(44.3-64.9)	183-235	(79.1-101.6)				(205.2-242.0)

Source: FRY OP. cit. page 128, Republic of Zambia, Ministry of Labour and Social Services Annual Report of the Department of Labour, various years and information supplied by the Copper Industry Service Bureau.

- a/ Deflated by the consumer price index for low income urban areas except for P11 where the index for higher income urban areas was used. Deflated figures are given in brackets.
- b/ Figures from 1961-1965 from FRY, then figures for "surface workman" and P1 surface from CISB.
- c/ Figures for Operator 1 from 1964-1969, then P5 from 1970. Figures supplied by CISB.
- d/ Figures from FRY.
- e/ Artisan foreman from 1964 to 1969, then P11 surface rate.

5.5 Investment in the mines

Costs, efficiency and productivity were affected by past investment in the mines which will be examined in this part of the chapter. Tables will be given for the accumulated net investment, in other words, the capital stock, and the nominal and real net investment by the two major groups.

5.5.1 The capital stock of the Roan Selection Trust/ Roan Consolidated Mines Group

In Table 5.16, two sub-totals are given for the accumulated gross and net investment outlays for the Roan Selection Trust group. One shows the expenditure on mining properties, such as Roan Antelope, Mufulira, Chibuluma and Chambishi, and the other that for expenditure on exploration and service companies. Rhodesian Selection Trust was, until the merger with Roan Antelope Copper Mines Ltd. in 1962, primarily a holding rather than an operating company. Its income came from the Mufulira and Chibuluma companies. After the merger, it became an operating company controlling not only the Luanshya and other mines but also exploration companies such as Mwinilunga Mines, small properties such as Kalengwa mine, important but as yet undeveloped properties such as the Baluba mine and service companies such as RST Administrative

Table 5.16

Roan Selection Trust/Roan Consolidated Mines

Fixed Assets
(K million)

Year ^{a/}	Mining Properties			Service & Exploration Companies			Total		
	Gross Expenditure to Date	Replacements	Net	Gross Expenditure to Date	Depreciation	Net	Gross Expenditure to date	Replacements or Depreciation	Net
1959	125.5	61.7	63.8	...	...	...	125.5	61.7	63.8
1960	134.0	65.6	68.4	...	...	...	134.0	65.6	68.4
1961	147.8	71.0	76.8	4.2	1.4	2.8	152.0	72.4	79.6
1962	147.9	75.4	72.5	18.0	2.5	15.4	165.9	77.9	87.9
1963	156.0	80.9	75.1	25.3	10.1	15.2	181.3	91.0	90.3
1964	168.3	85.5	82.8	29.3	12.9	16.4	197.6	98.4	99.2
1965	182.8	90.7	92.1	32.9	15.2	17.6	215.7	105.9	109.7
1966	182.8	90.7	92.1	32.9	15.2	17.6	227.4	113.0	114.4
1967	197.1	100.9	96.2	44.2	20.0	24.1	241.3	120.9	120.3
1968 ^{b/}	206.0	107.4	98.6	40.5 ^{b/}	19.7 ^{b/}	20.8 ^{b/}	246.5	127.1	119.5
1969	224.1	117.7	106.3	42.3	21.3	21.0	266.4	139.0	127.3
1969 ^{c/}	238.3	119.0	119.3	21.1	4.9	16.2	259.4	123.9	135.5
1970 ^{d/}							252.0	119.0	132.9
1970							264.7	124.3	140.5
1971							296.8	130.1	166.7
1972							330.3	133.0	197.4
1973							358.6	137.0	221.6
1974							385.2	149.0	236.2
1975							421.8	157.3	264.5
1976							456.1	161.0	295.1
1977							512.0	165.9	346.1
1978							563.3	170.3	393.0
1979 ^{e/}							589.2	175.8	413.5
1979 ^{f/}							428.7	20.0	408.7
1980 ^{g/}							456.7	37.8	418.9
1981 ^{g/}							512.0	58.2	453.8

Source: Roan Selection Trust, Roan Antelope Copper Mines and Roan Consolidated Mines Annual Reports, various years.

^{a/} For the years ending June 30th.

^{b/} RST Exploration ceased exploration in Zimbabwe and its assets were disposed of. (Roan Selection Trust Annual Report 1968, page 6.)

^{c/} Pro forma balance sheet of Roan Consolidated Mines on 31st December 1969 as calculated in Roan Selection Trust, Appendices to Explanatory Statement of Roan Selection Trust for Meetings of Shareholders to be held on 6th August 1970, 30th June 1970 page C-12.

^{d/} For January 1970.

^{e/} On the old accounting basis.

^{f/} On the new accounting basis.

^{g/} Fixed assets as of March 31st.

Services Ltd., and RST Technical Services Ltd. and the Ametalco Ltd. metal sales group that had a much larger clientele than just the Roan Selection Trust. ^{25/}

In 1969, the Zambian Government acquired a 51% interest in the operating mines, Mufulira, Chibuluma, Chambishi, Kalengwa and Luanshya and set up Roan Consolidated Mines. Only in February 1971 did this company acquire Baluba Mines Ltd. ^{26/} After the cancellation of the management contracts in August 1973, Roan Consolidated Mines began to take on more of the functions that had previously been performed by Roan Selection Trust. It can be seen then that Roan Consolidated Mines' fixed assets were in the early days near to those given as the mining properties of Roan Section Trust but, with time, came closer to those represented by the Trust's mining properties and exploration and service companies. The fixed assets of Roan Consolidated Mines were not disaggregated into mining properties and others as were those for Roan Selection Trust. However, in the Appendices to the Explanatory Statement ^{27/} issued in June 1970, the Trust set out what it thought would have been the fixed assets of Roan Consolidated Mines in December 1969, dividing them into mining assets, which were not markedly different from those shown for June 1969, and non-mining assets which were smaller than the figure for the service and exploration companies.

^{25/} The companies of the Roan Selection Trust group just before nationalization are given in Roan Selection Trust Ltd. Annual Report 1969, page 32. The Ametalco group of companies was purchased from the American Metal Climax in 1963 for 1 million shares. This purchase gave the Trust its first earnings base outside Zambia (U.S. Court of Appeals for the Third Circuit Harold E. Kohn v. American Metal Climax Inc. and Roan Selection Trust Ltd. (D.C. Civil No. 70-933) Joint Appendix page 314a.)

^{26/} Roan Consolidated Mines Annual Report 1971, page 4.

^{27/} See note c to Table 5.16.

The figures for 1959 to 1961 are obtained by adding the fixed assets figures for Roan Antelope Copper Mines Ltd. to those for Roan Selection Trust. No official figures were given of what Roan Selection Trust's balance sheet would have looked like before 1962 if it had absorbed Roan Antelope then and so these figures must be treated with caution, especially when a comparison between 1961 and 1962 is made.

Roan Selection Trust did not make any provision for the depletion or amortization of its capital expenditure. All expenditure which was regarded as creating or increasing the earning power of the mining properties was classed as capital expenditure. The accumulated total of this expenditure is described as net fixed assets in Table 5.16. That expenditure which was regarded as maintaining the assets' earning power was classed as replacements and was provided for by transfers from profits to provision for replacements. The total of the two is shown as gross capital expenditure.

Roan Consolidated Mines changed its accounting procedure with effect from July 1st 1970 (i.e., the change was seen in the 1971 accounts). Under the new basis, expenditure on items actually replaced was charged directly to operating costs. Some figures were given for this expenditure and are shown in Table 5.20. All other expenditure was classed as capital expenditure. Capital expenditure on assets which provided the necessary facilities and amenities for the efficient operation of the undertaking but which was not directly related to production was written off by transfers from profits appropriated for capital expenditure.^{28/} This figure is shown in the column for "Replacements".

^{28/} Roan Consolidated Mines Annual Report 1971, pages 6 and 13.

It can be seen that there was not a substantial difference between the definition of total net capital expenditure used by Roan Selection Trust and Roan Consolidated Mines. What changed was the treatment of replacements and other expenditure.

From 1st July 1979, Roan Consolidated Mines changed its accounting to a depreciation basis. Henceforth all expenditure on fixed assets was capitalised and depreciation was provided to write off the assets over the lower of the estimated useful life of the assets or the mines to which they related, subject to a maximum life of 25 years. Previous years' fixed assets were not revalued to reflect the change but depreciation would have amounted to more than the replacement expenditure charged to the cost of sales -- whereas the former would have come to K20 million in 1979, if the accounts had been prepared on the new basis, only K9.7 million had been charged as replacement expenditure to the cost of sales under the old accounting system ^{29/} and a further K5.5 million had been written off.

5.5.2 The capital stock of the Zambian Anglo American/ Nchanga Consolidated Copper Mines Group

In January 1970, the Zambian Government merged the mining undertakings, assets and liabilities of Rhokana Corporation, Nchanga Consolidated Copper Mines Ltd. and Rhokana Copper Refineries with Bancroft Mines Ltd. which was re-named Nchanga Consolidated Copper Mines Ltd. On 1st July 1970, the new Nchanga Company acquired the Kansanshi Copper Mining Company Ltd. and on 28th June 1971, but with retrospective effect to 1st January 1971, it acquired the properties and liabilities of Zambia Broken Hill Development Company Ltd., a lead and zinc producer.

^{29/} Roan Consolidated Mines Annual Report 1980, page 19.

Table 5.17 gives the accumulated total of capital expenditure and replacements outlays for the strictly copper companies from 1959 to 1969 and for these companies plus the Broken Hill Company. The small Kansanshi mine was not in operation during this period and is not included.

For the companies of the Zambian Anglo American group, expenditure during each year which was regarded as maintaining, as opposed to increasing, output was written off mining assets by transfers from profits appropriated for capital expenditure. The amounts written off are those shown in the column "Replacements". As with the Roan Selection Trust companies, no provision was made for depletion or depreciation. Instead, replacements were charged to operating costs or, in the case of certain short life equipment, by the operation of provision accounts.

The nationalized company adopted the same accounting rules as did Roan Consolidated Mines with the exception that, in the case of open pit vehicles, replacement expenditure was provided for by the operation of a provision account. Neither the movements on the provision account nor the amounts charged to operating costs were normally given in the company reports.

In the financial year 1978/79, the company changed its accounting system to the depreciation basis, as outlined above for Roan Consolidated Mines. Table 5.17 shows what the capital expenditure in 1977/78 on the old and the new accounting basis was. Previous years' balance sheets were not revised. It can be seen that, as with the Roan Consolidated Mines' results, the change scarcely affected the figure given for net capital expenditure.

5.5.3 Investment as measured by changes in fixed assets expenditure

Tables 5.18 and 5.19 are derived directly from Tables 5.16 and 5.17 and give the year to year changes in expenditure on fixed assets. Tables 5.20 and 5.21 give the increases in capital expenditure deflated by, for the period

Table 5.17

Zamanglo Group/Nchanga Consolidated Copper Mines Ltd.

Fixed Assets

(K million)

Year ^{a/}	Copper Companies ^{b/}			Copper Companies and Broken Hill Company		
	Gross	Replacements	Net	Gross	Replacements	Net
1959	176.1	41.6	134.2	193.4	42.7	150.7
1960	185.0	46.0	139.1	204.3	47.8	156.5
1961	193.4	51.7	141.7	219.5	53.9	165.6
1962	202.9	56.3	146.6	230.3	58.6	171.8
1963	216.5	61.5	155.0	244.0	63.9	180.2
1964	226.7	69.9	156.8	254.9	73.0	182.0
1965	240.1	80.8	159.3	269.2	84.7	184.5
1966	254.4	92.3	162.1	284.4	96.9	187.6
1967	276.3	106.3	170.0	306.8	111.5	195.3
1968	298.3	124.4	173.9	329.0	131.1	197.9
1969	323.1	129.8	193.3	354.5	138.4	216.1
1969 ^{c/}	346.0	134.4	211.6			
1970 ^{d/}				382.9	143.7	239.2
1971				426.3	153.0	273.2
1972				468.4	163.1	305.3
1973				527.2	170.3	356.8
1974				596.1	176.8	419.3
1975				655.0	185.7	469.2
1976				694.3	195.0	499.4
1977				710.4	200.0	510.4
1978 ^{e/}				733.6	215.4	518.2
1978 ^{f/}				549.8	28.5	521.3
1979				578.7	58.8	519.9
1980				639.6	90.7	548.9
1981				745.8	125.3	620.5

Source: Bancroft Copper Mines Ltd., Nchanga Consolidated Copper Mines Ltd., Rhokana Copper Refineries, Rhokana Corporation, Zambia Broken Hill Development Corporation Annual Reports.

^{a/} The totals for the financial years ending in the year shown. The financial years for the Rhokana and Rhokana Copper Refineries ended on June 30th. Until 1964, Bancroft's financial year ended on June 30th. After that, its financial year ended on March 31st. Nchanga's financial year ended on March 31st, both before and after nationalization. Broken Hill's financial year ended on December 31st.

^{b/} Bancroft Copper Mines, Nchanga Consolidated Copper Mines, Rhokana Copper Refineries and Rhokana Corporation.

^{c/} Figures for December 31st.

^{d/} Figures for January 1st.

^{e/} Under the old accounting system.

^{f/} Under the new accounting system.

Table 5.18

Roan Selection Trust/Roan Consolidated Mines									
Increases in Fixed Assets									
(K million)									
Year ^{a/}	Mining Properties			Service & Exploration Companies			Total		
	Replacements			Replacements			Replacements		
	Gross	ments	Net	Gross	ments	Net	Gross	ments	Net
1960	8.53	3.91	4.62	--	--	--	8.53	3.91	4.62
1961	13.76	5.36	8.40	4.15	1.41	2.75	17.92	6.76	11.15
1962	.11	4.46	-4.36	13.80	1.13	12.67	13.91	5.59	8.31
1963	8.15	5.49	2.66	1.57	1.80	-0.23	9.72	7.29	2.43
1964	12.26	4.53	7.73	4.00	2.78	1.22	16.27	7.32	8.95
1965	14.50	5.26	9.24	3.58	2.34	1.25	18.09	7.60	10.49
1966	7.77	4.97	2.80	3.96	2.11	1.85	11.74	7.08	4.65
1967	6.55	5.20	1.35	7.36	2.72	4.64	13.91	7.92	5.99
1968	8.89	6.50	2.39	-3.65 ^{b/}	-0.35	-3.30	5.24 ^{b/}	6.15	-0.91
1969	18.05	10.35	7.70	1.75	1.63	0.12	19.80	11.97	7.83
Amounts charged to operating costs									
1970 ^{c/}				...			12.74	5.22	7.51
1971				...			28.37	5.82	22.55
1972				...			35.56	2.88	30.67
1973				...			28.28	4.09	24.20
1974				...			26.63	11.94	14.69
1975				...			36.59	8.34	28.25
1976				12.07			34.23	3.66	30.57
1977				11.22			55.92	4.86	51.06
1978				8.69			51.31	4.41	46.89
1979 ^{d/}				9.69			25.96	5.51	20.45
1979 ^{e/}							35.66	19.97	15.68
1980 ^{f/}							28.01	17.84	10.17
1981							57.42	22.47	34.95

Source: Roan Selection Trust, Roan Antelope Copper Mines and Roan Consolidated Mines Annual Reports, various years.

/ For the financial years described in Table 5.3.
 / RST Exploration ceased exploration in Zimbabwe and its assets were disposed
 of (Roan Selection Trust Annual Report 1968 page 6).
 / For the six months ended June 30th 1970.
 / On the old accounting basis.
 / On the new accounting basis.
 / For the nine months ended March 31st 1980.

Table 5.19

Zamanglo Group/Nchanga Consolidated Copper Mines Ltd.:
Increases in Fixed Assets
(K million)

Year ^{a/}	Copper Companies ^{b/}			Copper Companies and Broken Hill Company		
	Gross	Replacements	Net	Gross	Replacements	Net
1960	8.96	4.09	4.86	10.94	5.10	5.84
1961	8.35	5.71	2.64	15.18	6.13	9.05
1962	9.52	4.66	4.87	10.86	4.66	6.21
1963	13.55	5.17	8.38	13.67	5.28	8.39
1964	10.22	8.42	1.80	10.93	9.13	1.80
1965	13.40	10.89	2.51	14.24	11.72	2.51
1966	14.30	11.52	2.78	15.27	12.14	3.12
1967	21.90	14.00	7.90	22.35	14.66	7.69
1968	22.04	18.08	3.96	22.25	19.62	2.63
1969	24.76	5.39	19.37	25.46	7.31	18.15
1969 ^{c/}	22.88	4.59	18.29	..	..	..
1971 ^{d/}	Amounts charged to			43.39	9.28	34.11
1972	operating costs			42.16	10.10	32.06
1973				58.74	7.22	51.52
1974				68.92	6.44	62.48
1975				58.89	8.97	49.93
1976				39.37	9.23	30.14
1977				16.06	5.02	11.07
1978 ^{e/}	23.2			23.22	15.46	7.76
1978 ^{f/}				46.40	28.50 ^{g/}	10.8
1979				29.40	30.80	-1.4
1980				63.20	34.20	29.0
1981				108.20	36.60	71.6

Source: Bancroft Copper Mines Ltd., Nchanga Consolidated Copper Mines Ltd., Rhokana Copper Refineries, Rhokana Corporation, Zambia Broken Hill Development Corporation Annual Reports.

^{a/} The totals for the financial years ending in the year shown.
^{b/} Bancroft Copper Mines, Nchanga Consolidated Copper Mines, Rhokana Corporation and Rhokana Copper Refineries
^{c/} The figures cover the nine month period from 31st March to 31st December for Nchanga Consolidated Copper Mines Ltd. and Bancroft Mines Ltd., and the six month period from 30 June for Rhokana Corporation and Rhokana Copper Refineries.
^{d/} 15 month period from 1st January 1970 to 31st March 1971.
^{e/} On the old accounting basis.
^{f/} On the new accounting basis.
^{g/} Another K 7.1 million representing the capital expenditure on the Kansanshi area that was written off as an extraordinary item was added to this figure.

1959 to 1965, the wholesale price of all building materials and, from 1966, the wholesale price of goods for fixed capital formation. The base was 1971. By 1981, these prices had risen over five times. By contrast, the GDP deflator, adjusted for changes in the terms of trade, trebled between 1971 and 1981, and so the deflated figures for the period of government ownership show quite different trends in real investment expenditures.

There are serious problems involved in deflating the figures for fixed assets expenditure, and especially the accumulated totals of expenditure. The company accounts talk of expenditure that maintains or increases the earning power of the assets, but this should better be understood as the productive capacity of the mines, rather than their earning power. For instance, if the price of copper went down, this would not have led to a fall in the figures for fixed assets and, indeed, if an investment were made to increase capacity this would have led to an increase in the net fixed assets as shown in the accounts. It would not, then, necessarily be correct to deflate a static figure for net fixed assets by any price index and conclude that this somehow showed a decline in the assets' earning power. In the case of the older mines this could have been misleading. Roan Antelope's net fixed assets, shown in the accounts, increased between 1941 and 1961 from £5.8 million to £6.6 million, whereas production rose from 67.7 to 81.8 thousand tons and profits after tax from £0.43 million to £2.7 million. ^{30/}

5.5.4 Investment as measured by development work completed

Another indicator of how much investment is being undertaken at the mines is the amount of development work -- shaft-sinking, stope preparation and main drives and crosscuts excavation -- completed. These figures are given in Tables 5.22 and 5.23. If the mines were being operated with a view to making

^{30/} All figures from Roan Antelope Copper Mines Ltd. Annual Reports.

Table 5.20

Roan Selection Trust/Roan Consolidated Mines
Increases in Fixed Assets (deflated) ^{a/}
(1971=100)

	<u>Expenditure on</u> <u>Mining Properties</u>			<u>Exploration and</u> <u>Service Companies</u>			<u>Total</u>		
	<u>Gross</u>	<u>Replace-</u> <u>ments</u>	<u>Net</u>	<u>Gross</u>	<u>Replace-</u> <u>ments</u>	<u>Net</u>	<u>Gross</u>	<u>Replace-</u> <u>ments</u>	<u>Net</u>
1960	12.35	5.66	6.69	--	-	-	12.35	3.66	6.69
1961	19.86	7.73	12.13	6.00	2.03	3.97	25.86	9.76	16.09
1962	0.15	6.42	-6.27	19.87	1.63	18.23	20.02	8.05	11.99
1963	11.55	7.78	3.77	2.22	2.55	-0.33	13.77	10.33	3.44
1964	16.57	6.12	10.44	5.40	3.76	1.64	21.97	9.88	12.09
1965	18.49	6.71	11.78	4.57	2.98	1.59	23.06	9.69	13.37
1966	9.19	5.87	3.31	4.68	2.50	2.19	13.87	8.37	5.50
1967	7.39	5.87	1.53	8.31	3.07	5.24	15.70	8.94	6.76
1968	9.98	7.30	2.68	-4.10 ^{b/}	-0.39	-3.70	5.89 ^{b/}	6.91	-1.02
1969	20.05	11.50	8.56	1.94	1.81	0.14	22.00	13.30	8.69
Amounts charged to operating costs									
1970 ^{c/}				...			13.81	5.66	8.15
1971				...			28.37	5.82	22.55
1972				...			30.68	2.64	28.04
1973				...			24.15	3.49	20.66
1974				...			20.06	9.00	11.07
1975				...			22.67	5.16	17.50
1976				5.63			15.97	1.71	14.26
1977				4.14			20.62	1.79	18.82
1978				2.48			14.66	1.26	13.40
1979 ^{d/}				2.35			6.30	1.34	4.96
1979 ^{e/}				...			8.65	4.84	3.80
1980 ^{f/}				...			6.08	3.87	2.21
1981				...			11.32	4.43	6.89

Source: Roan Selection Trust, Roan Antelope Copper Mines and Roan Consolidated Mines Annual Reports

- ^{a/} Deflated by the wholesale price of goods for fixed capital formation 1966-1981 and by the wholesale price of all building materials 1960-1965.
- ^{b/} RST Exploration ceased exploration in Zimbabwe and its assets were disposed of. (Roan Selection Trust Annual Report 1968, page 6.)
- ^{c/} For the six months ended June 30th 1970.
- ^{d/} On the old accounting basis.
- ^{e/} On the new accounting basis.
- ^{f/} For the nine months ended March 31st 1980.

Table 5.21
Zambian Anglo-American/Nchanga Consolidated Copper Mines Ltd.
Increases in Fixed Assets (deflated)^{a/}
(1971=100)

Year ^{b/}	Copper Companies			Copper Companies and Broken Hill		
	Gross	Replacements	Net	Gross	Replacements	Net
1960	12.95	5.92	7.03	15.82	7.37	8.45
1961	12.05	8.24	3.81	21.90	8.84	13.06
1962	13.71	6.70	7.01	15.64	6.70	8.94
1963	19.20	7.33	11.88	19.37	7.48	11.89
1964	13.81	11.38	2.43	14.77	12.34	2.43
1965	17.09	13.89	3.20	18.15	14.95	3.20
1966	16.90	13.62	3.28	18.04	14.35	3.69
1967	24.72	15.80	8.92	25.23	16.55	8.68
1968	24.77	20.31	4.45	25.00	22.05	2.95
1969	27.51	5.99	21.52	28.28	8.12	20.17
1969 ^{c/}	25.42	5.10	20.32	...	...	...
Amounts charged to operating costs						
1971 ^{d/}				43.39	9.28	34.11
1972				38.54	9.24	29.31
1973				50.17	6.17	44.00
1974				51.92	4.85	47.07
1975				36.48	5.55	30.93
1976				18.36	4.30	14.06
1977				5.92	1.85	4.08
1978 ^{e/}		6.6		6.64	4.42	2.22
1978 ^{f/}				13.26	8.14	3.09
1979				7.13	7.47	-0.34
1980				13.71	7.42	6.29
1981				21.33	7.22	14.11

Source: Bancroft Copper Mines Ltd., Nchanga Consolidated Copper Mines Ltd., Rhokana Copper Refineries, Rhokana Corporation, Zambia Broken Hill Development Corporation Annual Reports.

- ^{a/} Deflated by the wholesale price of goods for fixed capital formation 1966-1981, and by the wholesale price of all building materials 1960-1965.
^{b/} For the financial years described in Table 5.17
^{c/} See table 5.19, note c.
^{d/} 15-month period from 1st January 1970 to 31st March 1971.
^{e/} Under the old accounting system.
^{f/} Under the new accounting system.

the maximum profit in the shortest period of time, then we would expect to see little development work being completed. If, on the other hand, their long-term viability was a concern of the management, then we would expect to see development work continuing.

The one problem with this indicator is, of course, that it is only applicable in the case of underground mines and only the Chibuluma, Konkola, Luanshya-Baluba and Mufulira mines are solely underground mines. Until 1972, Chambishi was purely an open pit, but after that an underground mine was developed. Open pit mining ceased in December 1978. Nkana is predominantly an underground operation: the figures for 1982/83, show underground ore deliveries amounting to 3.93 million tonnes and open pit deliveries to 0.533 million tonnes. ^{31/} Nchanga, on the other hand is primarily an open pit operation with only 3.34 of the 9.93 million tonnes of ore treated coming from the underground sections in 1982/83. ^{32/}

5.6 Financing investment in the mines

The figures for fixed assets expenditure that we have used so far come from the companies' balance sheets. These not only give their other assets composed of investments, including those in subsidiary companies, and current assets such as stores, stocks of metals and concentrates and cash at hand -

^{31/} Zambia Consolidated Copper Mines Ltd. 1983 Annual Report, page 37. The Rokana division includes the Bwana Mkubwa mine which, in 1982/83 hoisted from its underground workings 0.42 million tonnes of ore. In February 1984, the mine ceased operations.

^{32/} ibid, page 33 - The Nchanga Division includes the Kansanshi open pit whose output, though, is very small - 86,618 tonnes in 1982/83.

Table 5.22

Roan Selection Trust/Roan Consolidated mines:
Mining development underground
(metres)

Year	Chambishi	Chibuluma	Luanshya and Baluba	Mufulira	Total
1960	..	13 108	79 751	82 621	175 480
1961	..	13 184	64 683	82 005	159 872
1962	..	15 581	59 783	63 552	138 916
1963	...	19 713	78 188	40 335	138 236
1964	..	14 606	75 484	53 076	143 166
1965	..	12 934	85 244	51 810	149 988
1966	..	8 332	63 153	48 421	119 906
1967	..	9 776	58 519	49 474	117 769
1968	..	10 874	46 628	47 159	104 661
1969	..	12 326	54 051	48 210	114 587
1970	2 147	8 482	50 678	38 702	100 009
1971	4 453	9 579	53 852	32 630	100 514
1972	5 174	10 098	67 553	41 760	124 585
1973	7 113	7 328	74 439	44 793	133 673
1974	7 779	8 697	74 092	44 490	135 058
1975	7 908	7 457	68 875	43 400	127 640
1976	7 236	6 476	68 998	42 533	125 243
1977	10 397	5 036	65 880	35 594	116 907
1978	11 047	3 354	53 121	26 470	93 992
1979	12 285	5 547	48 581	29 501	95 914
1980	20 743	6 491	59 366	31 057	117 657
1981	n.a.	n.a.	n.a.	n.a.	n.a.
1982	27 421	7 283	61 607	33 661	129 972
1983	31 120	6 465	63 126	33 780	134 491
1984	30 168	4 062	56 014	25 602	115 846

Source: Zambia Mining Yearbooks (various issues), and Zambia Consolidated Copper Mines Ltd. Annual Report 1982, page 51; Annual Report 1983, page 47; and Annual Report 1984, page 47.

Table 5.23

Zamanglo Group/Nchanga Consolidated Copper Mines; Zambia Total:
Mining development underground
(metres)

<u>Year</u>	<u>Chingola</u>	<u>Konkola</u>	<u>Nkana</u>	<u>Total</u>	<u>Zambia Total</u>
1960	52 454	50 664	98 812	201 930	377 410
1961	48 198	48 336	103 335	199 869	359 741
1962	49 123	51 989	99 289	200 401	339 318
1963	40 112	49 156	95 974	185 242	323 478
1964	34 949	41 276	72 862	149 087	292 253
1965	35 174	48 497	82 810	166 481	316 468
1966	45 107	49 072	90 386	184 565	304 471
1967	53 475	53 985	107 936	215 396	333 165
1968	48 499	58 456	105 707	212 662	317 324
1969	51 609	54 619	103 966	210 194	324 781
1970	47 579	53 860	105 486	206 925	306 934
1971	46 761	59 159	103 524	209 444	309 958
1972	59 144	50 982	94 130	204 256	328 841
1973	52 234	53 819	87 761	193 814	327 487
1974	52 527	59 093	84 548	196 168	331 226
1975	40 285	51 573	69 991	161 849	289 489
1976	46 596	48 292	69 193	164 081	289 324
1977	52 849	56 929	49 855	159 633	276 540
1978	53 063	48 338	52 011	153 412	247 404
1979	50 530	46 615	47 220	144 365	240 279
1980	46 196	45 302	44 248	135 746	253 403
1981	n.a.	n.a.	n.a.	n.a.	n.a.
1982	34 139	41 260	50 133	125 532	255 504
1983	31 405	37 469	48 325	117 379	251 870
1984	21 303	30 274	53 680	105 257	221 103

Source: Zambia Mining Yearbooks (various issues), and Zambia Consolidated Copper Mines Ltd. Annual Report 1982, page 51 and Annual Report 1983, page 47 and Annual Report 1984, page 47.

but also their liabilities. Normally current liabilities such as creditors, short term indebtedness, bank overdrafts and dividends payable are subtracted from current assets to arrive at net current assets. Adverse movements in net current assets would reduce the financial standing of the companies and, therefore, their ability to maintain their investment programmes.

Tables 5.25, 5.27 and 5.29 show the asset figures for the different groups. The figures for the pre-nationalization companies of the Zambian Anglo American group have simply been added together and so represent the composite result of a group of companies. No attempt has been made to arrive at net figures for the Zambian Anglo American group as a whole by netting out inter-company relationships.

To finance these assets the companies resorted to issuing shares, often at a premium, to building up reserves out of current and past profits and to long and medium term borrowing. The figures for these liabilities are given in Tables 5.24, 5.26 and 5.28. Alongside the figures for long and medium term indebtedness are given, in brackets, those for the total of short-term debt which would appear in the liabilities side of net current assets. We have drawn from these tables the total of short, medium and long-term indebtedness of the companies and the ratio of debt to fixed and total assets. These figures are given in Table 5.30.

Table 5.24

Roan Selection Trust/Roan Consolidated Mines

Liabilities: Share capital, long and medium term liabilities, reserves and replacements provisions 1960-1981
(Kmn)

Year ^{a/}	Share ^{b/} capital	Share premiums	Long and medium term liabilities ^{c/}	Short-term indebted- ness	Reserves	Provision for re- placements	Total
1960 ^{d/}	77.7	--	18.5	(--)	29.7	9.5	135.3
1961 ^{d/}	78.9	--	17.3	(0.2)	33.8	9.0	138.8
1962	68.8	30.9	18.1	(--)	19.4	8.6	145.7
1963	70.1	30.5	18.0	(--)	21.3	8.1	147.9
1964	74.8	30.9	20.0	(--)	21.3	8.7	155.5
1965	76.3	30.9	22.3	(--)	28.3	8.7	166.5
1966	77.1	31.3	22.3	(--)	32.4	10.4	173.5
1967	78.5	31.6	25.0	(--)	37.5	12.5	184.8
1968	78.5	31.6	21.4	(--)	54.7	13.3	199.5
1969	124.0	17.3	17.2	(--)	50.4	9.0	217.8
1970 ^{e/}	121.3	21.8	10.3	(5.1)	22.0	9.1 ^{f/}	180.5
1970	121.3	21.8	10.3	(1.4)	27.3	6.2	212.7
1971	121.3	21.8	13.2	(--)	56.5	-	250.7
1972	121.3	21.8	31.5	(--)	76.1	-	250.7
1973	121.3	21.8	45.9	(--)	89.3	-	278.1
1974	121.3	21.8	48.9	(--)	112.4	-	304.3
1975	121.3	21.8	71.3	(57.2)	129.9	-	344.2
1976	121.3	21.8	72.2	(95.3)	125.9	-	341.1
1977	121.3	21.8	77.7	(111.6)	141.9	-	362.7
1978	121.3	21.8	195.3	(80.9)	153.5	-	491.8
1979 ^{g/}	150.9	32.1	130.2	(59.9)	217.7	-	530.9
1979 ^{h/}	150.9	32.1	130.2	(59.9)	213.5	-	526.7
1980	150.9	32.1	98.7	(66.9)	282.8	-	564.5
1981	150.9	32.1	89.4	(58.4)	302.2	-	574.7

Source: Roan Selection Trust Annual Report 1969, pages 18-19, Roan Antelope Copper Mines Ltd. Annual Report 1960, 1961; Roan Consolidated Mines Annual Report, various years.

a/ Figures for the financial years described in Table 5.3.

b/ The figure for share capital from 1960-1969 is for the capital of Roan Selection Trust plus the interests of minority shareholders (principally Rhokana) in subsidiary companies.

c/ After 1973, payments due within one year were included in current liabilities. The amounts involved were, in 1973 K1.8 mn and, in 1974, for example, K 5.3 million.

d/ Figures for 1960 and 1961 are obtained by combining the accounts of Roan Selection Trust and Roan Antelope Copper Mines Ltd.

e/ Figure for January 1st 1970.

f/ This figure is for deferred income tax, not provision for replacements.

g/ Under the old accounting system.

h/ Under the new accounting system.

Table 5.25

Roan Selection Trust/Roan Consolidated Mines
Fixed Assets (net), investment and loans and net current assets 1962-1981
(Kmn)

Year ^{a/}	Fixed Assets (net)	Investments and Loans	Net Current Assets	Assets frozen through exchange restrictions	Total
1960	61.5	34.4	39.5		135.4
1961	70.5	36.8	31.5		138.8
1962	87.9	31.6	26.2		147.9
1963	90.3	31.0	26.7		149.9
1964	99.2	29.8	26.5		155.5
1965	109.7	33.8	23.0		166.5
1966	114.4	27.5	21.0	10.6	173.5
1967	120.4	28.6	25.2	10.7	184.8
1968	119.5	29.3	41.4	9.3	199.5
1969	127.3	27.6	57.0	6.0	217.8
1970 ^{b/}	132.9	15.1	36.4		184.4
1970	140.5	14.5	31.8		186.8
1971	166.7	17.4	28.6		212.7
1972	197.4	19.0	34.3		250.7
1973	221.6	21.3	35.3		278.2
1974	236.2	20.6	47.4		304.3
1975	264.5	21.7	44.0	14.0	344.2
1976	295.1	21.8	17.8	6.4	341.1
1977	346.1	23.5	-7.0		362.7
1978	393.0	50.4	48.4		491.8
1979 ^{c/}	413.5	51.4	60.0		530.9
1979 ^{d/}	408.7	51.4	66.6		526.7
1980	418.9	51.9	93.8		564.5
1981	453.8	53.0	67.9		574.7

Source: Roan Selection Trust Annual Report 1969, pages 18-19, Roan Antelope Copper Mines Ltd. Annual Report 1960, 1961 and Roan Consolidated Mines Annual Report, various years.

a/ Figures for the financial years described in Table 5.3.

b/ Figures for January 1st 1970.

c/ On the old accounting basis.

d/ On the new accounting basis.

Table 5.26

Zambian Anglo American/Nchanga Consolidated Copper Mines Ltd. (with Broken Hill)
Liabilities: Share capital, share premiums, reserves
and long and medium term liabilities
(Kmn)

<u>Year</u> ^{a/}	<u>Share Capital</u>	<u>Share Premiums</u>	<u>Reserves</u>	<u>Long and Medium Term Liabilities</u>	<u>Short term indebtedness</u>	<u>Accumulated Loss</u> ^{b/}	<u>Total</u>
1960	143.1	25.8	46.6	20.7	(--)	-4.1	232.1
1961	143.0	25.8	53.3	23.3	(--)	-3.8	241.6
1962	143.4	27.0	61.7	25.3	(--)	-3.8	253.6
1963	144.3	29.5	64.1	23.2	(2.2)	-3.8	257.3
1964	144.2	29.5	60.4	25.4	(--)	-2.1	257.4
1965	126.6	17.4	74.3	10.1	(--)		228.4
1966	126.9	17.4	80.4	8.9	(1.5)		233.6
1967	126.8	17.4	89.2	10.1	(12.7)		243.5
1968	126.7	17.4	99.6	7.9	(10.2)		251.5
1969	126.6	17.4	138.0	28.6	(7.7)		310.6
1970	248.5		--	23.2	(--)		271.7
1971	251.0		60.5 ^{c/}	22.6	(2.6)		334.1
1972	254.0		79.7	41.1	(5.9)		374.7
1973	253.8		119.9	45.4	(7.2)		419.1
1974	253.6		159.7	41.6	(26.5)		455.0
1975	253.5		192.3	96.7	(28.7)		542.6
1976	253.5		187.9	139.7	(111.0)		581.1
1977	253.3		185.3	140.6	(145.7)		579.3
1978 ^{d/}	253.3		188.9	168.5	(101.1)		610.7
1978 ^{e/}	253.2		230.1	168.5	(101.1)		651.8
1979	310.1		255.5	83.4	(179.3)		649.0
1980	310.0	--	302.3	66.2	(162.6)		678.5
1981	309.9	--	329.9	112.7	(151.7)		752.5

Source: Bancroft Copper Mines Ltd., Nchanga Consolidated Copper Mines Ltd., Rhokana Copper Refineries, Rhokana Corporation, Zambia Broken Hill Development Corporation Annual Reports.

a/ For the financial years described in Table 5.17.

b/ Bancroft mines only.

c/ Includes K 3.3 million in notes and shares to be issued to Zambia Copper Investments Ltd.

d/ Under the old accounting system.

e/ Under the new accounting system.

Table 5.27

Zambian Anglo American/Nchanga Consolidated Copper Mines Ltd.

(with Broken Hill)

Fixed assets (net), investments and loans and net current assets 1960-1981
(Kmn)

<u>Year</u> ^{a/}	<u>Fixed Assets (Net)</u>	<u>Investments and loans</u>	<u>Net Current assets</u> ^{b/}	<u>Deferred Expenditure</u>	<u>Total</u>
1960	156.5	49.8	25.8		232.1
1961	165.6	53.2	22.8		241.6
1962	171.8	64.7	17.1		253.6
1963	180.2	66.1	11.0		257.3
1964	182.0	64.8	10.6		257.4
1965	184.5	61.4	-17.6		228.4
1966	187.6	61.8	-15.6		233.6
1967	195.3	63.9	-15.6		243.5
1968	197.9	67.2	-13.4		251.5
1969	216.1	72.8	21.9		310.6
1970	212.2	13.2	46.2		271.7
1971	273.2	15.9	44.0	1.0	334.1
1972	305.3	18.8	50.7		374.7
1973	356.8	22.9	39.4		419.1
1974	419.3	19.6	16.1		455.0
1975	469.2	17.3	32.0	24.0	542.5
1976	499.4	18.5	49.5	13.8	581.1
1977	510.4	22.6	38.8	7.5	579.3
1978 ^{c/}	518.2	50.1	42.4		610.7
1978 ^{d/}	521.3	50.1	80.4		651.8
1979	519.9	52.3	76.8		649.0
1980	548.9	55.6	74.0		678.5
1981	620.5	56.8	75.2		752.5

Source: Bancroft Copper Mines Ltd., Nchanga Consolidated Copper Mines Ltd., Rhokana Copper Refineries, Rhokana Corporation, Zambia Broken Hill Development Corporation Annual Reports.

a/ For the financial years described in Table 5.17.

b/ Includes stores as assets.

c/ Under the old accounting system.

d/ Under the new accounting system.

Table 5.28
Zambian Anglo American (without Broken Hill)
Liabilities: Share capital, share premiums, reserves
and long term indebtedness

<u>Year</u> ^{a/}	<u>Share</u> ^{b/} <u>Capital</u>	<u>Share</u> <u>Premiums</u>	<u>Reserves</u>	<u>Long and</u> <u>Medium Term</u> <u>Liabilities</u>	<u>Short term</u> <u>indebted-</u> <u>ness</u>	<u>Accumulated</u> <u>Loss</u> ^{c/}	<u>Total</u>
1960	136.6	25.7	35.8	16.9	(--)	-4.1	210.9
1961	136.5	25.7	42.2	16.4	(--)	-3.8	216.9
1962	136.9	26.9	50.8	16.1	(--)	-3.8	226.9
1963	137.8	29.4	52.0	16.5	(--)	-3.8	231.9
1964	137.8	29.4	46.6	18.7	(--)	-2.1	230.4
1965	120.1	17.3	60.1	4.6	(--)		202.1
1966	120.6	17.3	65.4	4.2	(--)		207.5
1967	120.4	17.3	74.7	3.8	(12.5)		216.2
1968	120.4	17.3	84.5	3.3	(10.2)		225.5
1969	120.3	17.3	122.9	24.1	(7.7)		284.6

Source: Bancroft Copper Mines Ltd., Nchanga Consolidated Copper Mines Ltd., Rhokana Copper Refineries, and Rhokana Corporation Annual Reports, various years.

a/ For the financial years described in Table 5.17.

b/ Includes an outside interest (worth K 0.2 million) in a subsidiary of NCCM.

c/ Bancroft Copper Mines only.

Table 5.29
Zambian Anglo American (without Broken Hill)
Assets: Fixed assets, investments and loans, and net current assets

<u>Year</u> ^{a/}	<u>Fixed Assets</u> <u>(net)</u>	<u>Investments</u> <u>and loans</u>	<u>Net</u> ^{b/} <u>current assets</u>	<u>Total</u>
1960	139.1	49.8	22.1	210.9
1961	141.7	52.9	22.2	216.9
1962	146.6	64.4	15.9	226.9
1963	155.0	65.9	11.0	231.9
1964	156.8	64.6	9.0	230.4
1965	159.3	61.2	-18.5	202.1
1966	162.1	61.6	-16.2	207.5
1967	170.0	63.8	-17.6	216.2
1968	173.9	67.0	-15.4	225.5
1969	193.3	72.7	18.6	284.6

Source: Bancroft Copper Mines Ltd., Nchanga Consolidated Copper Mines Ltd., Rhokana Copper Refineries, and Rhokana Corporation Annual Reports, various years.

a/ For the financial years described in Table 5.17.

b/ Includes stores as assets.

Table 5.30

The total indebtedness of the companies and the ratio of debt to shareholders' funds
(K million and percentage)

Year ^{a/}	Total Debt (Kmn)			Total Borrowings/ Shareholders Funds (%)			Long and Medium Term Debt/ Shareholders Funds (%)		
	NCCM			NCCM			NCCM		
	RST/RCM	with Broken Hill	without Broken Hill	RST/RCM	with Broken Hill	without Broken Hill	RST/RCM	with Broken Hill	without Broken Hill
1960	18.5	20.7	16.9	15.8	9.8	8.7	15.8	9.8	8.7
1961	17.5	23.3	16.4	14.4	10.7	8.2	14.2	10.7	8.2
1962	18.1	25.3	16.1	14.2	11.1	7.6	14.2	11.1	7.6
1963	18.0	25.4	16.5	13.9	10.9	7.7	13.9	9.9	7.7
1964	20.0	25.4	18.7	14.8	10.9	8.8	14.8	10.9	8.8
1965	22.3	10.1	4.6	15.5	4.6	2.3	15.5	4.6	2.3
1966	22.3	10.4	4.2	14.7	4.6	2.1	14.7	4.0	2.1
1967	25.0	22.8	16.3	15.6	9.8	7.7	15.6	4.3	1.8
1968	21.4	18.1	13.5	12.0	7.4	6.1	12.0	3.2	1.5
1969	17.2	36.3	31.8	8.6	12.9	12.2	8.6	10.1	9.3
1970 ^{b/}	15.4	23.2		9.3	9.3		6.3	9.3	
1970	11.7		--	6.8			6.0	--	
1971	13.2	25.6	--	6.6	8.2		6.6	7.3	
1972	31.5	47.0	--	14.4	14.1		14.4	12.3	
1973	45.9	52.6	--	19.8	14.1		19.8	12.1	
1974	48.9	68.2	--	19.1	16.5		19.1	10.1	
1975	122.1	125.4	--	44.8	28.1		26.1	21.7	
1976	167.5	250.7	--	62.3	56.8		26.8	31.6	
1977	189.3	286.3	--	66.4	65.3		27.3	32.0	
1978	276.2	269.6	--	92.5	61.0	(55.8) ^{c/}	65.9	38.1	(34.9) ^{c/}
1979 ^{c/}	190.1	262.7	--	47.9	46.4		32.5	14.7	
1980	165.6	228.8	--	35.5	37.4		21.2	10.8	
1981	147.9	264.4	--	30.5	41.3		18.4	17.6	

Source: Roan Selection Trust, Roan Antelope Copper Mines, Roan Consolidated Mines, Bancroft Copper Mines Ltd., Broken Hill Development Company, Nchanga Consolidated Copper Mines Ltd., Rhokana Copper Refineries and Rhokana Corporation Annual Reports

^{a/} For the financial years described in Table 5.3 and 5.17.

^{b/} 1st January 1970

^{c/} Under the new accounting system.

5.7 Expenditure on Exploration

There are no annual figures that we have seen for the amount of total expenditure on exploration in Zambia or for some other variable that indicated the intensity of operations -- say the footage drilled. To show the trend in exploration will, then, be more difficult.

The post nationalization period was expected to lead to an increase in exploration as the old companies lost most of their exclusive concessions and the country was opened up to new entrants. In Table 5.32 we give details for the expenditure of these new entrants and of the time period during which they conducted their operations. The expenditure is divided between outside companies and parastatal Zambian organizations.

Table 5.31 gives prospecting expenditure that was begun before 1970. It is divided into that expenditure which had ended by 1970, that which ended after 1970 and, finally, that which was still continuing in 1983.

The total expenditure detailed in Tables 5.31 and 5.32, that is the total of prospecting expenditure outside the Copperbelt, amounted to K 102.01 million (all at current prices). By comparison, prospecting expenditure in the Copperbelt from 1948-1983 is expected to have amounted to about K 70 million and at Kabwe (Broken Hill) to about K 4 million over the same period^{34/}.

^{34/} Information supplied privately by Zambia Appointments Ltd., London.

Table 5.31

Prospecting Expenditure begun before 1970

Company	Time period	Expenditure (K million)
AAC: Kasampa Minerals Ltd.	1957-1967	0.41
AAC: Barotseland Exploration Ltd.	1962-1964	0.2
RST: Kadola Mines Ltd.	1953-1969	3.0
Minerals Search of Africa (Rio Tinto)	1955-1965	3.0
Frobishers	1956-1960	2.0
New Consolidated Goldfields (with RST and AAC)	1955-1957	0.5
Sub-Total		9.11
Chartered Exploration Ltd. (Zamanglo Exploration after 1970)	1955-1975	15.8
RST/RCM: Mwinilunga	1948-1975	15.0
RST/RCM: Chisangwa	1948-1973	5.0
RST/RCM: Lusaka East	1955-1975	2.0
Sub-Total		37.8
De Beers	1955-present	10.0
Geological Survey of Zambia	1955-present	6.0
Sub-Total		16.0
Total		62.91

Source: Privately supplied by Zambia Appointments Ltd., London.

Table 5.32

Details of identifiable prospecting outside the Copperbelt after 1970

Company	Time period	Expenditure (K million)
GEOMIN (Romania)	1972	2.0
SIDCO (Yugoslavia)	1969-1974	0.5
Metallimex (Czechoslovakia)	1972-1978	0.2
SWICO and PNC (Japan)	1972-present	1.0
AGIP-Nucleare (Italy)	1972-present	15.0
United Nations	1969-1973	2.5
Noranda	1974-1978	0.8
Saarberg-Interplan	1978-present	5.0
BRGM (France)	1981-present	0.1
Sub-total		27.1
Mindeco (Zambia)	1970-1978	6.0
MINEX (Zambia)	1975-present	12.0
Total		39.1

Source: Privately supplied by Zambia Appointments Limited, London.

5.8 Summary

In this Chapter, we have amassed and put on comparable bases and, where feasible, calculated in real terms the data that will be used in the subsequent analysis of the performance of the Zambian copper mining industry. We gave figures for Zambian copper and cobalt production and for the share of Zambian copper production in world market economies and developing countries' production. We then gave figures for the size of the labour force, for ore production and for the grade of ore milled. We calculated annual copper and ore production per employee and per local employee. Statistics were given on the technical efficiency of the concentrators and on accident rates at the mines.

After these physical data, we compiled statistics on the costs of production, on labour costs and earnings, on the capital stock of the mines and on annual net investment. We deflated the relevant figures to show trends in real expenditure. Investment could also be judged by the underground development work undertaken for which data were also collected.

We gave figures for the asset and liabilities sides of the companies' balance sheets in order to show how investment was financed, and drew out from these data figures for the long and short-term indebtedness of the companies.

Finally, we gave figures for the expenditure on exploration both by the main producers and by other companies before and after nationalization.

THE ZAMBIAN COPPER INDUSTRY BEFORE NATIONALIZATION

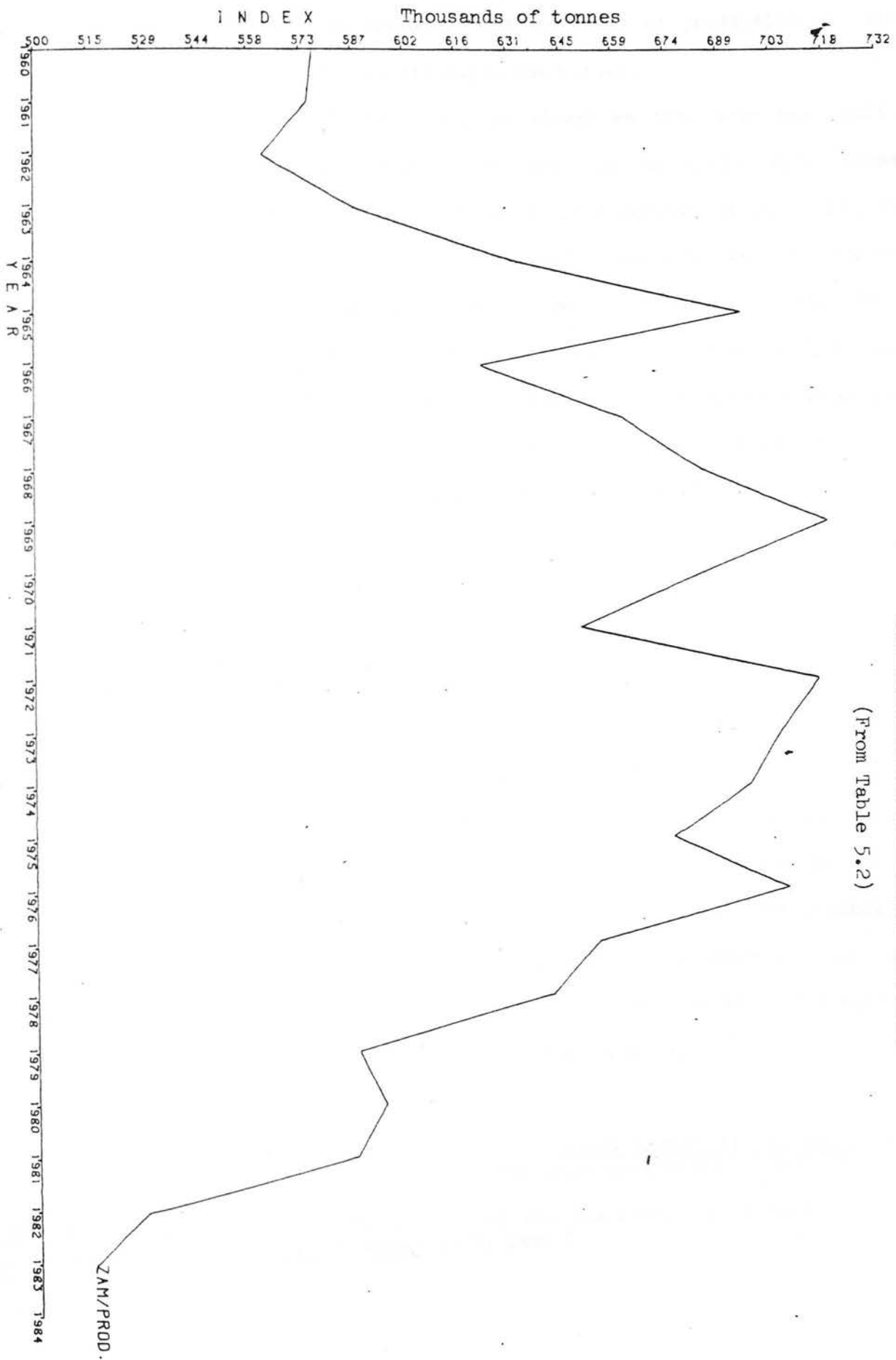
The performance of the industry before nationalization was a crucial determinant of the Zambian government's decision to nationalize it. There might have been some lingering hostility towards the industry because of the delay in breaking the colour bar, but this was hardly important in making the Government decide to nationalize the industry in 1969. Moreover, it was its performance in the decade before nationalization and especially after Independence, in October 1964, that most attracted the Government's comments and criticisms and so we are justified in looking in depth only at this decade for an appreciation of the pre- as opposed to post-nationalization performance of the industry.

6.1 Copper production

One of the most crucial indicators of performance was the level of copper production which was given in Table 5.2 and is here reproduced in Graph 6.1. Copper production rose from 576.4 thousand tonnes of recoverable copper in 1960 to 719.5 thousand tonnes in 1969. However, it was only in 1969 that production reached and surpassed its total of 1965.

6.1.1 The effect of production controls

The reason for this was that for much of the earlier period controls were maintained by the Zambian and other producers on production or sales in order to balance supply with demand. Since 1958 production had been held back but in January 1960, all restrictions placed on the production of copper by the world's producers were removed. However, in October of that year Zambian producers again decided to try to balance global supply with demand. Roan Selection Trust cut production by 10 per cent and Zambian Anglo American reduced sales by the same percentage. In July 1962, these cuts were increased to 15 per cent. Only in early 1964 were full scale production and sales resumed when demand was outstripping supply. For the rest of the period of



Graph 6.1 Zambian copper production, 1960-1983

(From Table 5.2)

private ownership, the Zambian producers did not restrict production or sales as part of any concerted effort to stabilize the market.

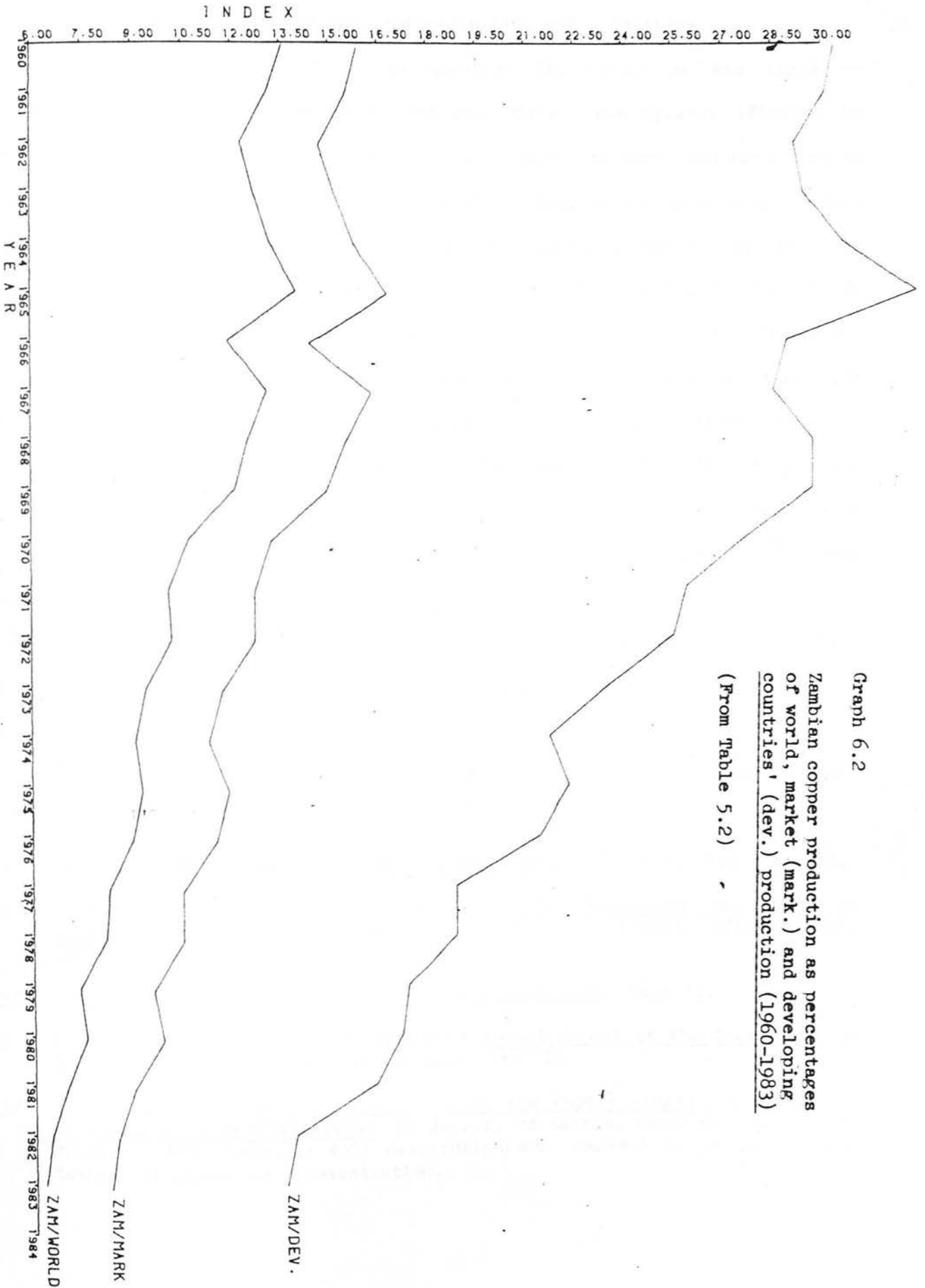
The years 1964 and 1965 can, then, be viewed as ones when the Zambian producers expanded production rapidly to come up to their more normal production rates. In 1965, Zambian production as a percentage of world, the market economies' and the developing countries' production was the highest that it was to reach in this period, as can be seen in Graph 6.2. After 1965, Zambia's share in the production of all three categories slipped until it was, even in 1969, slightly below that in 1960. The fall in production from 1965 is then a reflection of the Zambian producers' inability to sustain the burst in production that came after the removal of controls in early 1964.

6.1.2 Rhodesian UDI and production

What can help to explain the absolute and relative fall in production after 1965 are the events occurring after the Unilateral Declaration of Independence by Southern Rhodesia in November 1965 and the general adjustment in the industry to Zambia's Independence and Zambianization. The effects of Rhodesia's Unilateral Declaration of Independence will be treated in Chapter 9, but Zambia's having to adjust rapidly to a disruption of its established trading patterns would clearly have tended to affect adversely the output of the mining industry. In September 1966, the mines had to restrict production to 75% of normal output mainly as a consequence of a shortfall in fuel supplies for smelting operations caused by Zambia's adopting sanctions against Rhodesia.^{1/} Full scale production only resumed in June 1967.^{2/}

^{1/} Republic of Zambia, Ministry of Labour. Annual Report of the Department of Labour for the year 1966, Lusaka, The Government Printer 1967, page 1.

^{2/} RST Group of Companies "Statement by the Chairman, Sir Ronald L. Prain OBE" to accompany Annual Report 1967, page 3.



Graph 6.2

Zambian copper production as percentages of world, market (mark.) and developing countries' (dev.) production (1960-1983)

(From Table 5.2)

6.1.3 Independence, Zambianization and production

It is even more difficult to quantify the effect of the shock of Independence and Zambianization on output. Output was clearly affected by strikes, of which there were two major ones in 1966, in March and April and in August and September^{3/}, but output was also affected in more subtle ways. One report, by Professor H. A. Turner of Cambridge University for the International Labour Office stated, in 1969, that "The reason for this fall in labour efficiency seems to be basically that the colonial system of labour discipline has broken down and nothing has yet developed to take its place."^{4/} Whatever the merits and demerits of the colonial system of labour discipline, both expatriate and Zambian workers had to adjust in a very short period of time to a very deep change in their relationships. Some expatriates claimed that they were unable to maintain discipline on the job.^{5/} They were afraid to exercise their authority in case there were accused of racism and deported.^{6/} On the other hand, Zambians felt, with Independence, that they should no longer tolerate certain insulting behaviour by expatriate supervisors.^{7/}

In view of the potential for a major explosion, the fact that the Zambian

3/ Copperbelt of Zambia Mining Industry Year Book 1966, Nkola 1966, page 15.

4/ International Labour Office: Report to the Government of Zambia on Incomes, Wages and Prices in Zambia, Lusaka, Government Printer 1969, page 14.

5/ Copperbelt of Zambia Mining Industry Year Book 1966, page 21.

6/ Republic of Zambia, Ministry of Labour Annual Report of the Department of Labour for the year 1966, Lusaka, 1967, page 13.

7/ Michael Burawoy The Colour of Class on the Copper Mines: From African Advancement to Zambianization, University of Zambia, Institute of African Studies, 1972, contains full descriptions and analyses of expatriate and Zambian attitudes to Zambianization.

copper mining industry was able to meet the challenge of Independence and Rhodesian Unilateral Declaration of Independence and to see production in 1969 reach a record level must be considered a substantial achievement. The Mining Journal's view was that the achievements of the copper mining industry "despite many severe problems" had been "remarkable".^{8/} This assessment referred not only to the increased output of industry, but also to achievements in other directions - such as the "relatively smooth application of the policy of Zambianization."

It should be remembered that the effect of the shocks administered to the industry at around the time of Independence and the Rhodesian Unilateral Declaration of Independence could be expected to diminish over time. In this respect, only one year in the post-Independence period, 1966, saw production fall below its level of the previous year. Subsequent years saw a revival in output.

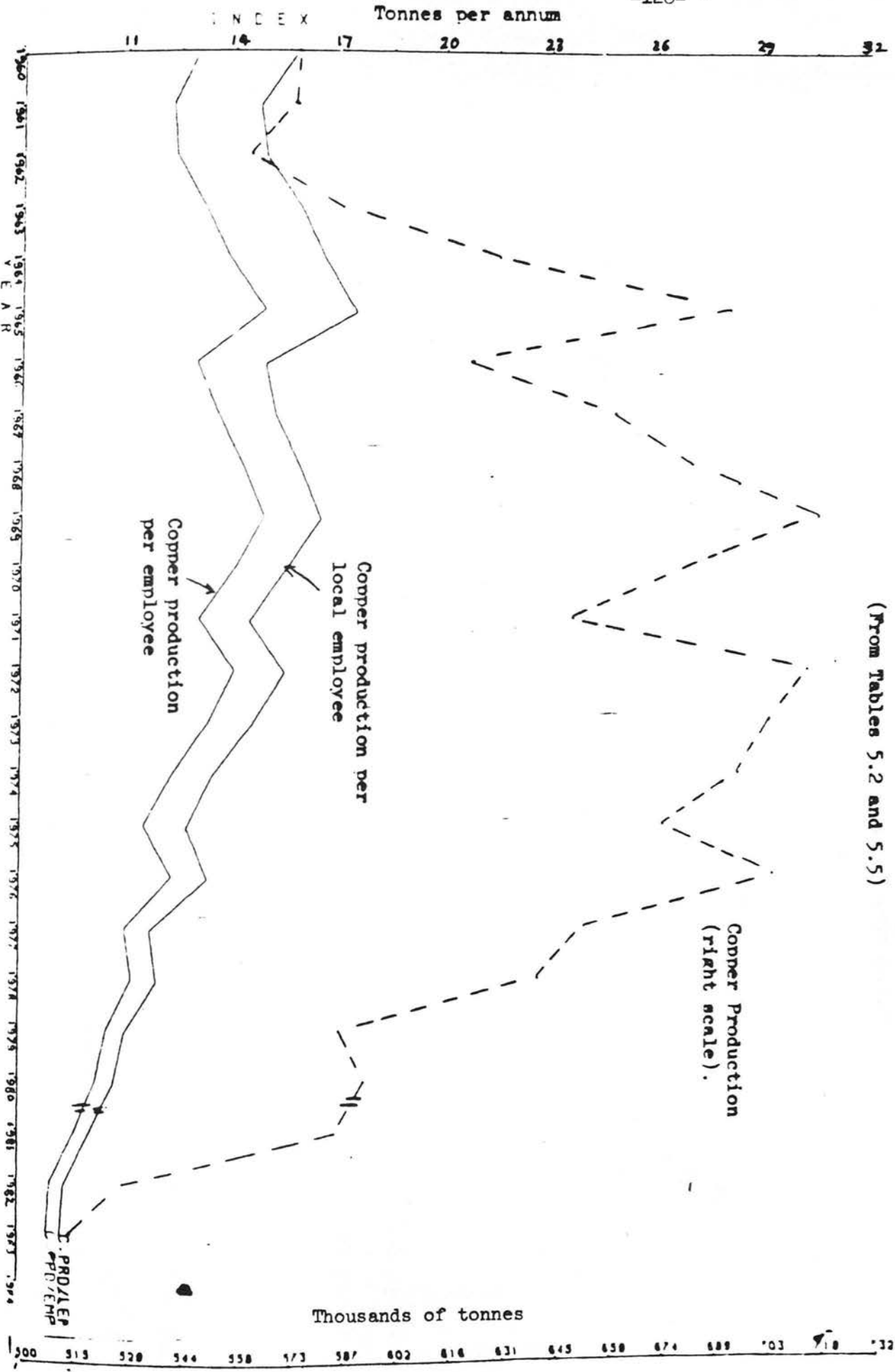
6.2 Productivity and Efficiency

6.2.1 Copper and ore production per employee

Trends in productivity and efficiency also give an indication of how well the industry coped with the transition from colonial rule to Independence. The productivity figures in Table 5.5 and Graph 6.3 show that, in terms of copper production per employee and per local employee the trend was generally upward in the years 1960 to 1969. Productivity dropped off with the fall in output in 1966. Indeed, 1965, the year of highest copper production before 1969 saw copper output both per employee and per local employee at a maximum.

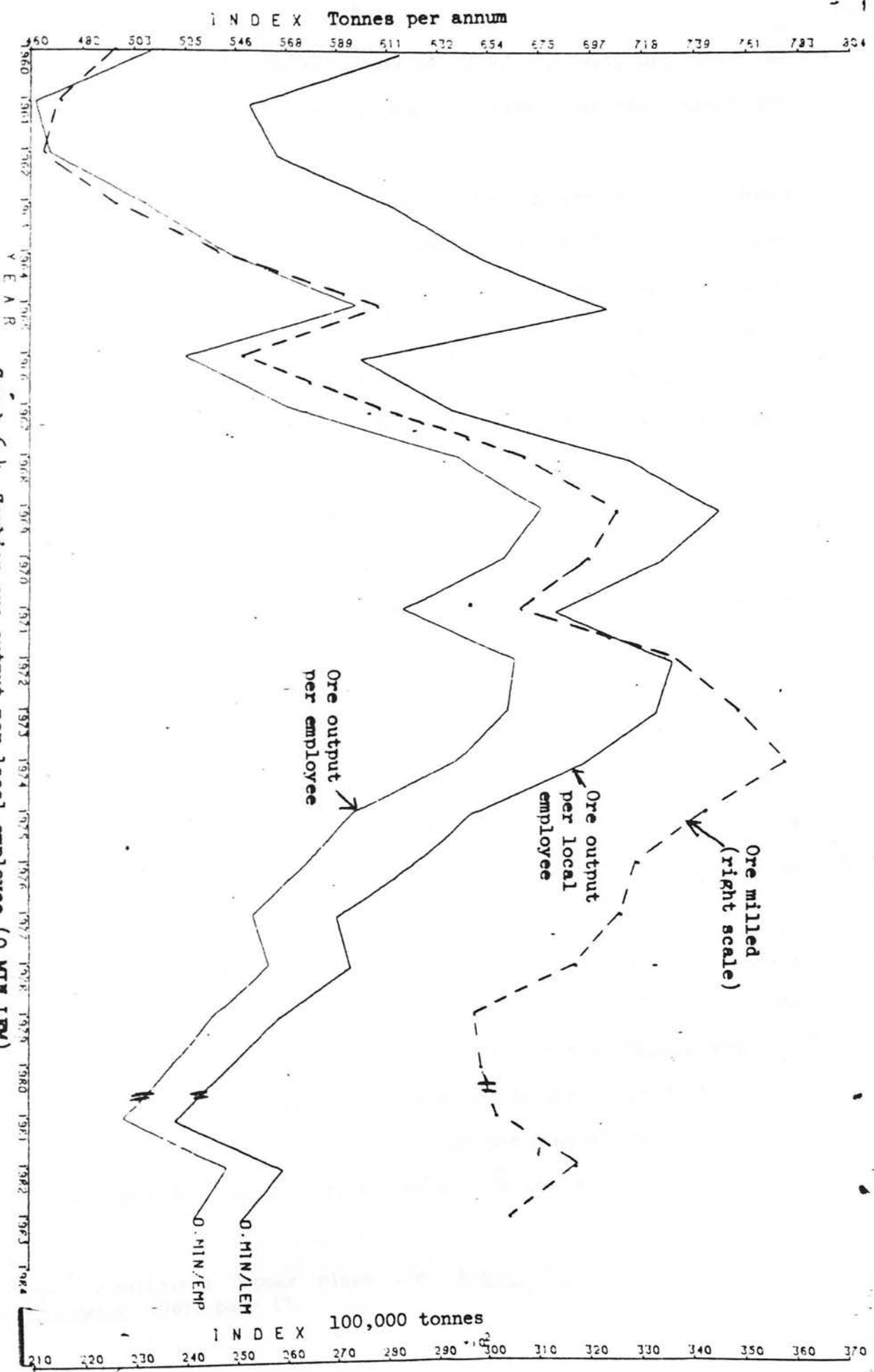
Productivity measured in terms of ore mined per employee and per local employee displayed a much stronger upward trend as shown in Graph 6.4. It also was very closely followed by movements in total ore output. Thus, a sharp fall in productivity was recorded in 1966 but the peaks reached in 1969

^{8/} Mining Journal, November 22nd 1968, page 393.



Graph 6.3 Zambian production of copper per local employee (C.PR.D.LPM), and per employee (C.PR.D.EMP) with copper production superimposed

(From Tables 5.2 and 5.5)



Graph 6.4

Zambian ore output per local employee (O.MIN.LEM) and per employee (O.MIN.EMP) with ore milled superimposed

(From Tables 5.4 and 5.5)

were substantially above the previous peaks of 1965. By 1969, ore mined per local employee was 22 per cent higher than in 1960, and that mined per employee 33 per cent higher.

The difference between these two figures lies in the fact that local employment grew more quickly than total employment as Zambians replaced expatriate workers. As Table 5.6 shows, the ratio of expatriate to local employees fell substantially between 1960 and 1969 -- from 20.5 per cent to 10.9 per cent -- as the number of expatriate workers declined by 2,801 or 36 per cent. In the same period the local labour force grew by 3,893 or nearly 9 per cent.

6.2.2 The efficiency of metallurgical operations

The sharp reduction in the expatriate labour force did not have an adverse effect on production or productivity, as we have seen, nor even on metallurgical operations where it might have been thought that the expatriates' expertise would have been most needed. As Table 5.8 shows, the recovery rates improved at Luanshya and Nkana and showed little change at Mufulira and Chibuluma. Recovery rates did decline somewhat at the Konkola and Nchanga mines but this was hardly surprising as both mines produced oxide as well as sulphide ores and as the Konkola concentrator treated much of Nchanga's ore over this period.

Sulphides are relatively easy to treat, as shown by the high recovery rates at Mufulira and Luanshya whose ores are predominantly sulphides. On the other hand, the recovery from oxide ores is lower and the Nchanga mine was steadily producing relatively larger amounts of oxide ores. In 1959/60, the ration of oxide to sulphide ores passing through the Nchanga concentrator was 1.07 and in 1968/69 1.98.^{9/} Moreover, as the mine is predominantly open

^{9/} Nchanga Consolidated Copper Mines Ltd. Annual Report 1960, page 11, Annual Report, 1969, page 17.

pit, it brings to the surface material that might be left behind in an underground mine.

Great efforts were made by the Nchanga company to extract as much copper as possible from the material being brought to the surface. One result was that the average grade of ore passing through the concentrator declined -- from 5.37 per cent in 1959/1960, made up of 2.77 per cent oxide copper and 2.60 per cent sulphide copper, to 3.81 per cent in 1968/69, made up of 2.53 per cent oxide copper and only 1.28 per cent sulphide copper.

The leach plant at Nchanga consequently expanded in complexity and capacity -- from 6,000 tonnes of cathode copper per month in 1960 to 9,900 tonnes in 1972^{10/} -- to treat the low grade oxide and sulphide ores coming from the open pits. In December 1962, a low grade oxide section was commissioned and enabled copper production to rise by increasing recovery at the concentrator rather than by increasing ore production. The rate of copper recovery from oxides passing through the concentrator consequently rose from 83.89 per cent in 1961/62 to 86.45 per cent in 1962/63 and to 90 per cent in 1963/64. However, from 1966 to 1969, this plant was closed because of acid shortages and technical problems.

In June 1964, another plant, designed to roast low grade sulphide concentrates, was commissioned. Roasting converted this material, which could not be so economically treated at the smelter, into oxides or sulphates, which were then treated in the normal way at the leach plant. This plant operated very successfully.^{11/}

^{10/} Bosse P.J.W. "New Developments at the Leach Plant at Nchanga Consolidated Copper Mines Ltd., Chingola Division" Geologie en Mijnbouw 51 (May/June 1972) page 404.

^{11/} Ibid., page 411.

Two new sections were added to the leach plant after the Government assumed a 51 per cent ownership of the industry. However, both had been in consideration before 1970 because of the problems that arose as the percentage of oxide to sulphide ores had continued to increase and as the volume of low grade oxide concentrates that were difficult to treat had grown. The first section, (Stage I), which came into operation in October 1971, was a leach cementation plant designed to treat the large stockpile of low grade oxide concentrates^{12/}, current arisings of this material and also leach residues. The second section (Stage II) first came on line in April 1974 and used a solvent extraction process - itself developed in the United States in the 1960's - instead of cementation to treat current tailings, reclaimed tailings from the old slimes' dam and residues^{13/}. It was the largest plant in the world to use this technology and so, unsurprisingly, initial problems were encountered which prevented the realisation of the production targets set - 55,000 tons of copper per annum over a twelve year period from the annual treatment of 12 million tonnes of material.^{14/}

Although not part of the Nchanga Leach Plant, another plant of particular interest to Nchanga was the TORCO (Treatment of Refractory Copper Ores) plant at Nkana. This plant, designed to treat principally micaceous and silicate ores that are neither floatable nor leachable, provided an excellent example of the length of time required to develop new technical processes. Work started on the TORCO process in 1961, in 1963 a pilot plant was built at

^{12/} By 1 April 1969, Nchanga had accumulated a stock-pile of 847,411 tons of oxide concentrate containing over 27,000 long tons of copper, of which almost 17,500 accrued in 1968/69. (Nchanga Consolidated Copper Mines Ltd. "Review by the Chairman, Mr. H. F. Oppenheimer" to accompany Annual Report, 1969).

^{13/} Mining Magazine, February 1974, page 100.

^{14/} Mining Annual Review, 1976, page 444, 1977, page 484 and Nchanga Consolidated Copper Mines Ltd. "Review by the Chairman, Mr. H. F. Oppenheimer", 4 May 1970.

Nchanga to treat 10 tons of ore a day^{15/} and, in October 1965 a commercial scale 500 tonne a day plant was commissioned at Nkana to treat the refractory ores of Mindola Open Pit. Modifications were made to this plant to allow it to come into full commercial operation in January 1967.

Its subsequent history has not justified the early optimism that "it could be one of the most important developments in the copper industry for many years"^{16/}. No other units were built at Nkana as had been hoped, and plans to use the TORCO process to treat Kansanshi's ores^{17/} were abandoned in favour of transporting the ore for treatment in Chingola's leach plant^{18/}. Also, Roan Selection Trust, which acquired a licence from Zambian Anglo American to use the process on its own ores, and built a pilot plant in the mid 1960's at Mufulira, gave up the project after it realized that the process, to be economical, required a higher grade of ore than was available in Zambia. It lost about \$1 1/2m in the venture.^{19/} Operations ceased at the TORCO plant in May 1983 because of the high and uneconomical costs of ore treatment.^{20/} A similar treatment process undertaken by Charter Consolidated^{21/} Akjoujt, Mauritania, also proved to be unsuccessful, and the plant was closed in May 1978.^{21/}

It will be noted, that most of the material to be treated by the TORCO and the Nchanga leach plants did not come from new mines but rather from existing open pits. The costs involved in obtaining this material were so low

^{15/} World Mining, December 1966, page 20.

^{16/} World Mining, December 1966, page 20.

^{17/} World Mining, February 1967, page 46.

^{18/} Mining Annual Review, 1972, page 345. (So far, though, Kansanshi has not come into full scale production).

^{19/} From discussion with Mr. Jean Vuillequez.

^{20/} Zambia Consolidated Copper Mines Ltd, Annual Report, 1984, page 38.

^{21/} Mining Annual Review, 1980, page 540.

as to offset the higher costs of treatment through the complicated new processes^{22/}. When the material was already at hand, as with the old tailings that had a grade of under 1 per cent copper, no costs of ore extraction were involved.^{23/}

The costs at any one section of the complex Nchanga leach plant cannot be viewed in isolation because often the justification for using a particular process was that it would enable another more important section to be operated more efficiently. The roasting plant, for instance, was constructed so that the grade of sulphide concentrates going to the smelter would be increased and that plant's performance improved with the removal from the circuit of the low grade sulphide concentrates which had a high silica content^{24/}. Furthermore, the transformation of copper sulphides into copper sulphates increased the production of acid, which was in short supply, as copper sulphate produced sulphuric acid on electro-winning^{25/}.

The experience of Nchanga also illustrated how, in examining the treatment of different ores to produce copper, the sole consideration was not just the cost of the copper produced but also that of mining and treating those ores that were not immediately treated to produce copper because of bottlenecks in the treatment plant. The change in mineralization at the mine

22/ Cf. World Mining, December 1966, page 20. Unfortunately the mines of the Zambian Anglo-American group, neither before nor after nationalization, published detailed costs figures for the different treatment processes that would be useful for our study. However, the validity of the above argument can be appreciated from the temporary closing, in 1976, of the Mindola open pit and the Rhokana Division oxide concentrator that treated its ores. The flotation performance had been very poor (Nchanga Consolidated Copper Mines Ltd. Annual Report, 1974, page 23), and the mine did not contain compensating high grade sulphides.

23/ Mining Magazine, February 1974, pages 100, 101.

24/ BOSSE op. cit., page 411.

25/ Ibid. pages 411, 413.

from sulphides to oxides placed heavy strains on the Zambian Anglo American group's smelter at Nkana and forced the group in 1968 to stock-pile low grade oxide concentrates.

We have discussed the Nchanga treatment plant at some length because it does illustrate that the companies went to considerable efforts to improve their recovery rates. Both this specific example and also the overall figures for recovery rates at the other concentrators show that in the period before nationalization there was no real deterioration in the efficiency of the treatment operations.

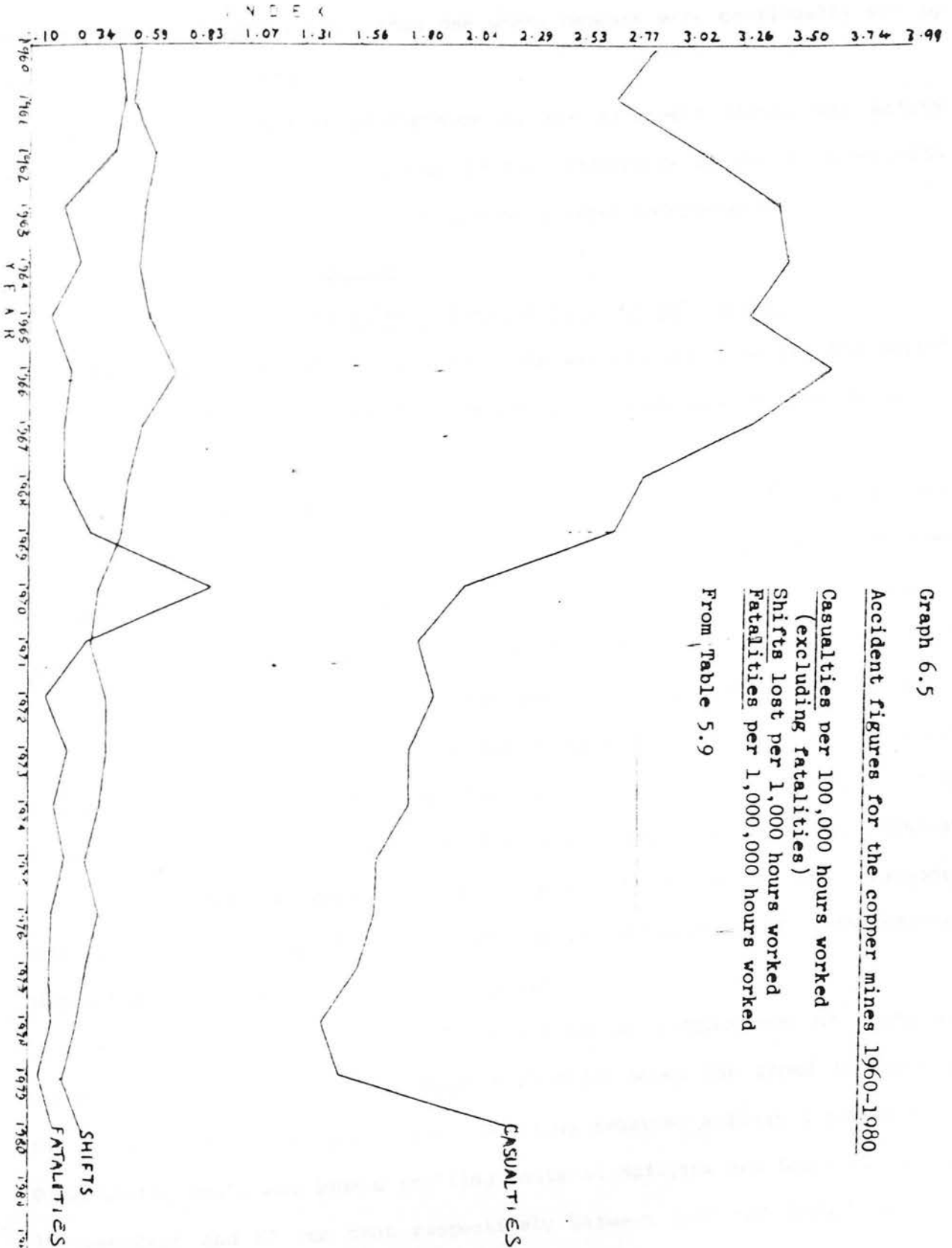
6.2.3 The safety record

The other related measure of technical performance we discussed in Chapter 5 was the safety record. The figures in Table 5.9 which are reproduced in Graph 6.5, show that, on the whole, shifts lost through accidents and non-fatal casualties increased up to 1966, after which they began to fall quite steadily. One reason for this could have been the generally unsettled atmosphere in the mines at the time of Independence with the consequent weakening of labour discipline as referred to above.^{26/}

Another important factor making for increasing safety was the sharp fall in the turn-over rate for local employees as the labour force stabilized. In 1960 the annual turnover was 28.33 per cent, but by 1963 it had fallen to 9.23 per cent. The figure stood at 7.28 per cent in 1966 and 6.35 per cent in 1969. As a result, the average length of service of the local employee rose from 5.2 years in 1960 to 9.4 years in 1969^{27/}. A more experienced work

^{26/} Republic of Zambia Ministry of Labour Annual Report of the Department of Labour for the year 1966, Lusaka, 1967, page 13 and Annual Report of the Department of Labour for the year 1967, Lusaka 1969, page 9.

^{27/} Mindeco Mining Yearbook of Zambia 1970, page 46 and Copperbelt of Zambia Mining Industry Year Book 1968, page 47.



force was one which would have had a greater amount of time to learn about and to practise safety precautions than one whose members were continually moving out into other employment.

As with the technical proficiency of the treatment plant, the safety figures do not indicate any collapse in the performance of the industry with Independence, but rather an actual improvement after Independence.

6.3 The Costs of production

6.3.1 Costs of sales and production: overall trends

While technical efficiency of operations was maintained during the period of private ownership, figures for the costs of production do not paint so encouraging a picture.

As can be seen from Table 5.10, between 1961 and 1969, the Roan group's total cost of sales per tonne increased by 71 per cent or by K244, from K344 to K588. The figures for the cost delivered buyers of electrolytic copper given in the same table point to a similar pattern - these costs increased by K258, or by 71 per cent, between 1961 and 1969, with royalties and export taxes, both taxes on production, increasing by K159. The other costs, which were within the companies' control, therefore increased by nearly K100, or by 32 per cent. Most of this increase, K63, was caused by increases of costs at the mine as can be seen from graph 6.6. In spite of the transport difficulties caused by Rhodesia's Unilateral Declaration of Independence, direct transport costs increased by only K18.

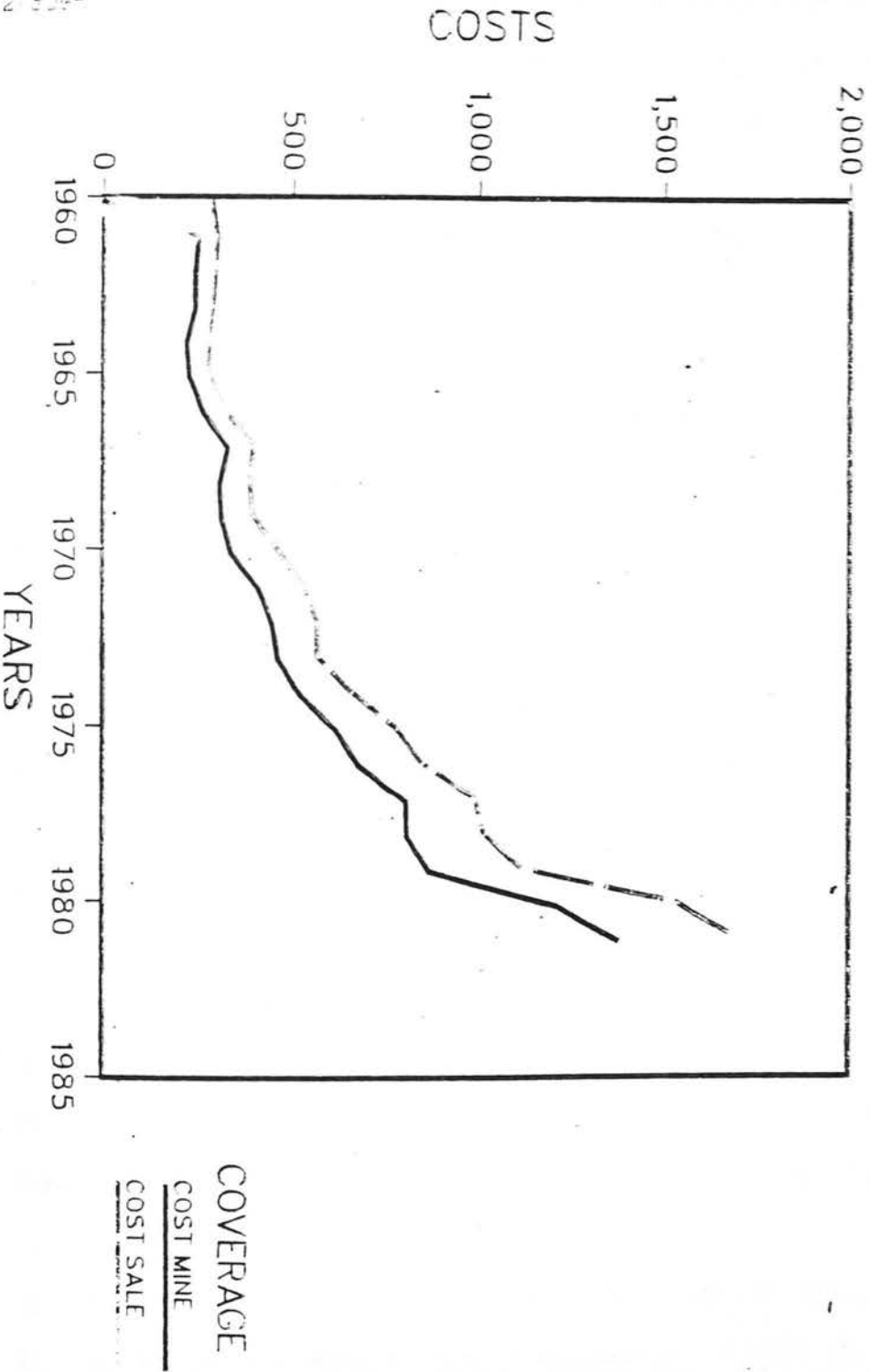
The effects of the Unilateral Declaration of Independence on costs are perhaps more clearly seen from Table 5.12 which shows the trend in costs at the different stages of production. Smelting requires a large input of fuel, particularly coal, and indeed smelting costs at Mufulira and Luanshya rose by 168 per cent and 62 per cent respectively between 1965 and 1969. No other component of costs - mining, concentrating or refining - showed a comparable

Graph 6.6

RST/RCM: Costs of sales less production taxes
(cost sale) and costs f.o.r. mine (cost mine)
K per tonne, 1960-1981

From Table 5.10

ROAN SELECT TRUST/ROAN CONSOLIDATED MINES



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AS OF JUNE 1984

increase. The use of lower grade coal from Zambia rather than the higher-grade Wankie coal from Rhodesia was partly responsible for this large increase. Lower grade coal adversely affected efficiencies.^{28/}

Table 5.12 also shows that mining costs per tonne of ore in 1960 were lower at Luanshya than at Mufulira but by 1969 were higher. This reflected the approaching exhaustion of the former mine. As deeper and more difficult ore-bodies had to be extracted to maintain production,^{29/} mining costs could only be expected to increase, and there would be very little that could be done to arrest this trend.

6.3.2 The costs of production when deflated

It is difficult to choose a suitable deflator for the costs of production. We are essentially dealing with an industry in competition on world markets, and so would like to see whether cost trends in Zambia were unfavourable relative to trends elsewhere. A domestic deflator, such as the Zambian wholesale price index or the Zambian GDP deflator is largely irrelevant for this exercise. The measure we have chosen is the unit value index in U.S. dollars of the manufactured goods exports of the developed market economies, as published by the United Nations. This gives an indication of the trend in world prices in dollar terms. The Zambian cost figures are in Kwachas, but this presents no conceptual problems as we really do not want the figures to have been adjusted for devaluations, as they would be if we were comparing two Kwacha indices. One of the problems of Zambia's open economy is that increases in the costs of producing copper that would

^{28/} Roan Selection Trust Annual Report 1969, page 26 and 1968, page 26.

^{29/} cf PRAIN, Sir Ronald: "MacLaren Shaft". Speech at opening of MacLaren Shaft, Roan Antelope, August 16th, 1963 in Selected Papers Vol. III (1961-1964) London 1964 pages 113-114, and Economist December 16th 1961.

render the industry uncompetitive and bring about a devaluation would not be in the country's interests in so far as the costs of imports, including those for the mining industry, would rise.

Using this export price index as a deflator, the figures given in Table 6.1 were calculated. The first two columns are given in Graph 6.7 and show a favourable downward trend for real mine costs free on rail (f.o.r.) and costs of sales less royalties and export taxes for the years until 1965. Between 1965 and 1969 real costs at the mine and costs of sales less royalties and export taxes increased by 30 per cent and 33 per cent respectively. The really large increase was seen in the total cost of sales, of 54 per cent, as royalties and export taxes rose sharply. The net result was that between 1961 and 1969 real costs at the mine increased by 13.2 per cent, the cost of sales less royalties and export taxes by 20 per cent and the total costs of sales by 55 per cent.

6.4 Labour costs and problems

6.4.1 The increase in labour costs 1965-1966

Table 5.10 and graph 6.6 showed that the greatest increase in mining costs in the pre-nationalization period took place between 1965 and 1967. As previously mentioned, part of the explanation lies in the effects of Rhodesia's Unilateral Declaration of Independence, but part also lies in the sharp increase in labour costs. Table 5.13 showed that these costs rose from K101 per tonne of copper in 1964 to K143 per tonne in 1967. As a share of total costs of sales, less royalties and export taxes, they increased from 34 to 37 per cent. The percentage increase was moderated by the fact that transport and other costs also increased between these two years.

6.4.2 The Brown Award, 1966

Table 5.15, and Graphs 6.8 and 6.9 which were derived from it, show nominal and inflated wage rates and identify the major cause of the rise in labour costs as the salary increases granted between April 1965 and October 1966. The wage award of October 1966 was the most notable, and controversial

Table 6.1 Roan Selection Trust/Roan Consolidated Mines:
Cost figures electrolytic copper (deflated, 1975=100) a/

<u>Year</u>	<u>Costs</u> <u>f.o. r. mine</u>	<u>Cost of sales</u> <u>less royalties</u> <u>and export tax</u>	<u>Total cost</u> <u>of sales</u>
1960		617	726
1961	532.1	634	732
1962	514.3	626	726
1963	516.4	613	713
1964	456.9	575	681
1965	466.5	569	735
1966	541.0	649	896
1967	658.4	792	1232
1968	615.6	774	1172
1969	602.1	760	1131
1970	628.9	859	
1971	710.3	910	
1972	723	915	
1973	636	777	
1974	588	740	
1975	619 (619)	778 (778)	
1976	667 (642)	830 (799)	
1977	739 (713)	909 (877)	
1978	647 (669)	812 (839)	
1979	607 (648)	779 (831)	
1980	768 (825)	973 (1046)	
1981	926 (902)	1139 (1109)	

Source and Notes: As in Table 5.10

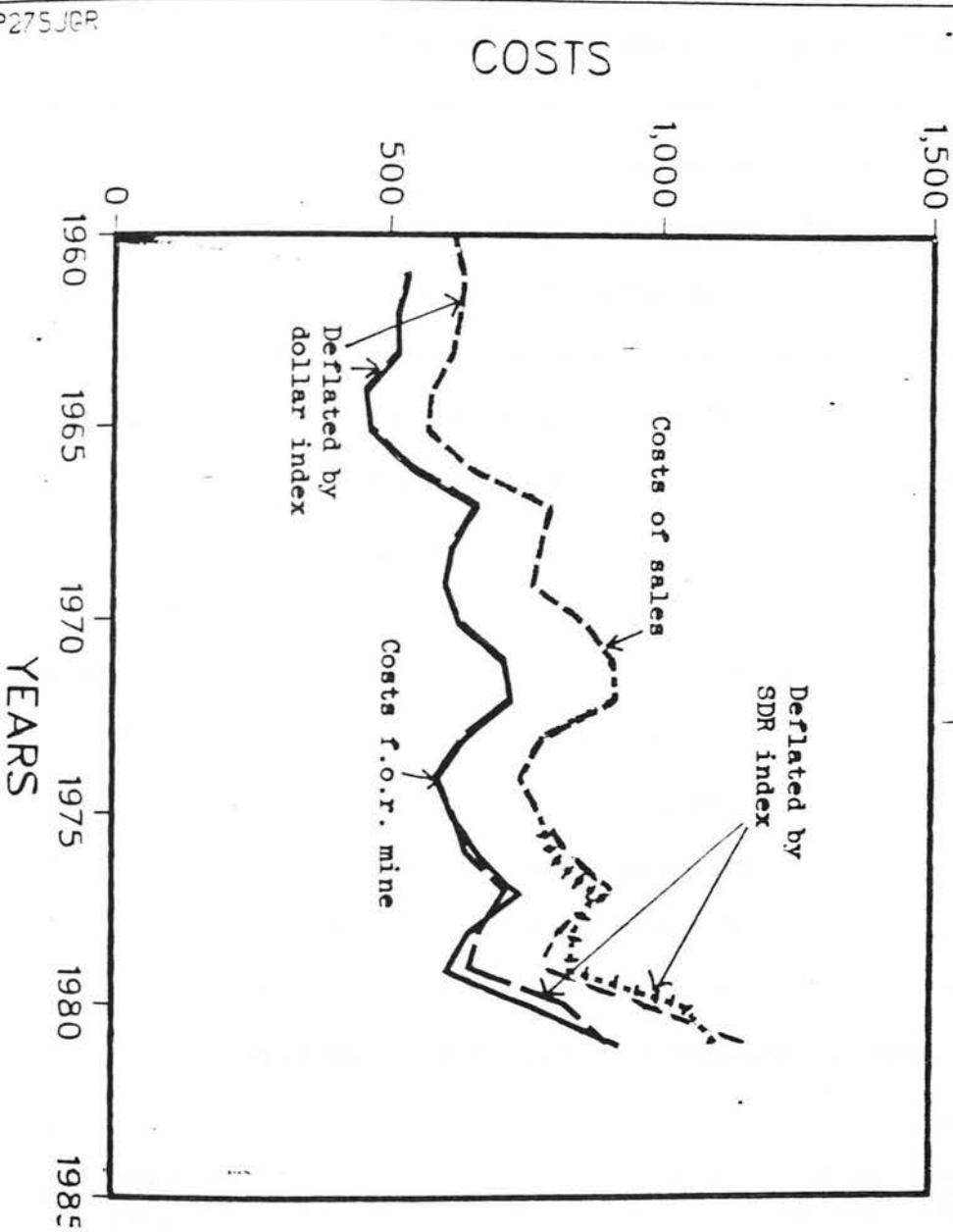
a/ Deflated by the Unit value indices of the exports of manufactured goods from the developed market economies, in U.S. dollars, given in the U.N. Monthly Bulletin of Statistics. Figures in brackets are for the comparable index in Special Drawing Rights.

Graph 6.7

RST/RCM: Costs of sales less production taxes,
and costs f.o.r. mine, deflated (1975=100)
K per tonne, 1960-1981

(From Table 6.1)

ROAN SELECT TRUST/ROAN CONSOLIDATED MINES



in the history of the Zambian mining industry and is generally known as the Brown award after the Chairman of the Commission of Inquiry, Roland Brown, that recommended it.^{30/}

There had been an earlier agreement, in January 1966, which provided for an average increase of 8 per cent in wages^{31/}, but this did not prevent the outbreak of serious strikes, beginning in March 1966. The Brown Commission, appointed as a result of these strikes to restore peace to the industry, decided that there should be a single basic scale for all employees in the industry^{32/}, and recommended that there be a uniform increase in the existing local scale of 22 per cent -- this figure being chosen because it was one third of the difference between the local and expatriate wage rates for Shift Bosses.^{33/} In choosing such a large wage increase, the Commission hoped inter alia to "remove the sense of injustice which permeated the relations between labour and management in the mining industry".^{34/}

The Commission spent some time arguing that it was not going against the recommendations of the earlier Report drawn up in 1964 for Zambia by a United Nations team under Professor Dudley Seers, and also invariably known after its Chairman. This Report had stated boldly that "There is really a choice for Zambia: in the next five years it can have big increases in wages or big increases in employment, not both" (the Report's emphasis).^{35/} The

^{30/} Republic of Zambia. Report of the Commission of Inquiry into the Mining Industry 1966. Under the Chairmanship of Mr. Roland Brown, Lusaka, Government Printer 1966.

^{31/} ibid. page 29.

^{32/} ibid. page 42.

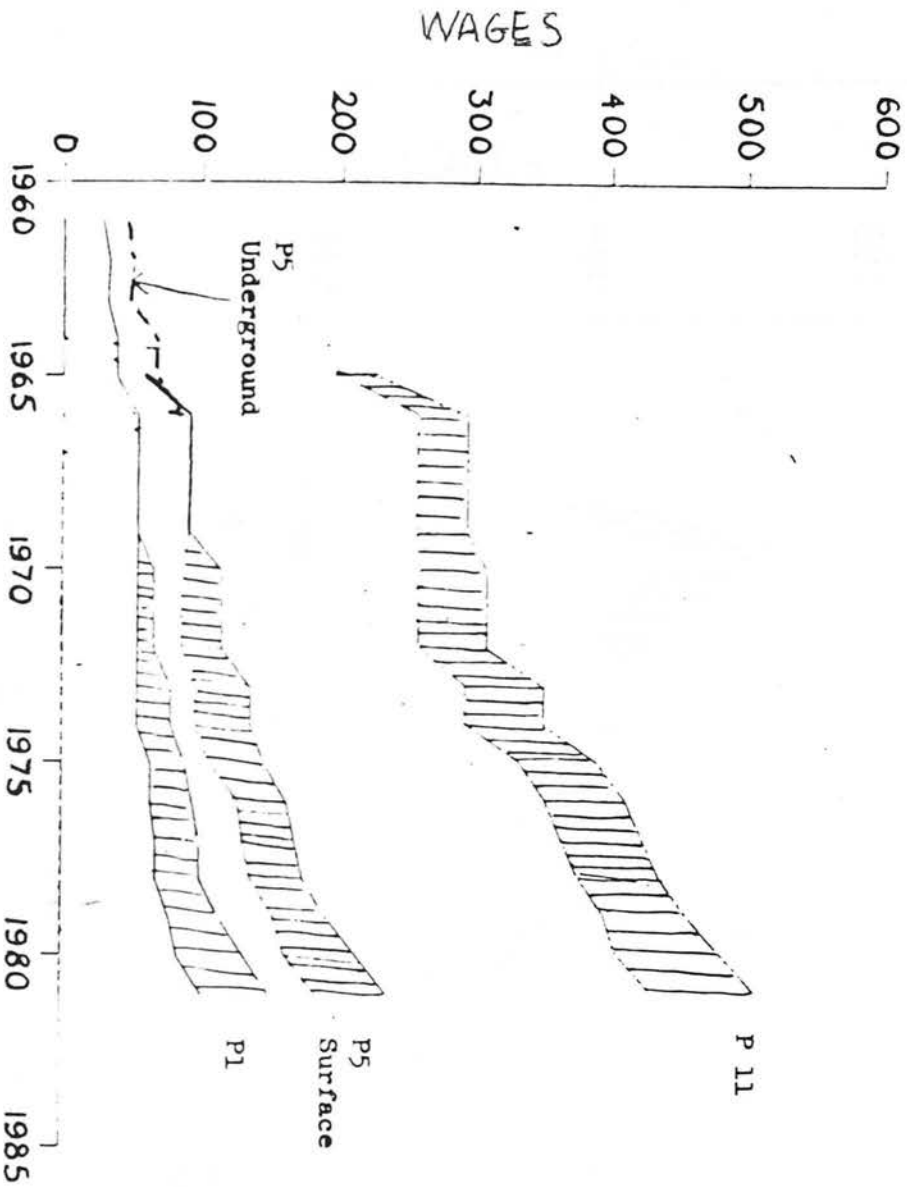
^{33/} ibid. pages 45-46.

^{34/} ibid. page 48.

^{35/} United Nations/FAO/ECA Economic Survey Mission on the Economic Development of Zambia Ndola 1964, pages 32-33.

Graph 6.8 Local wage rates in nominal terms
K per annum
From Table 5.15

LOCAL MINE WORKERS' WAGES

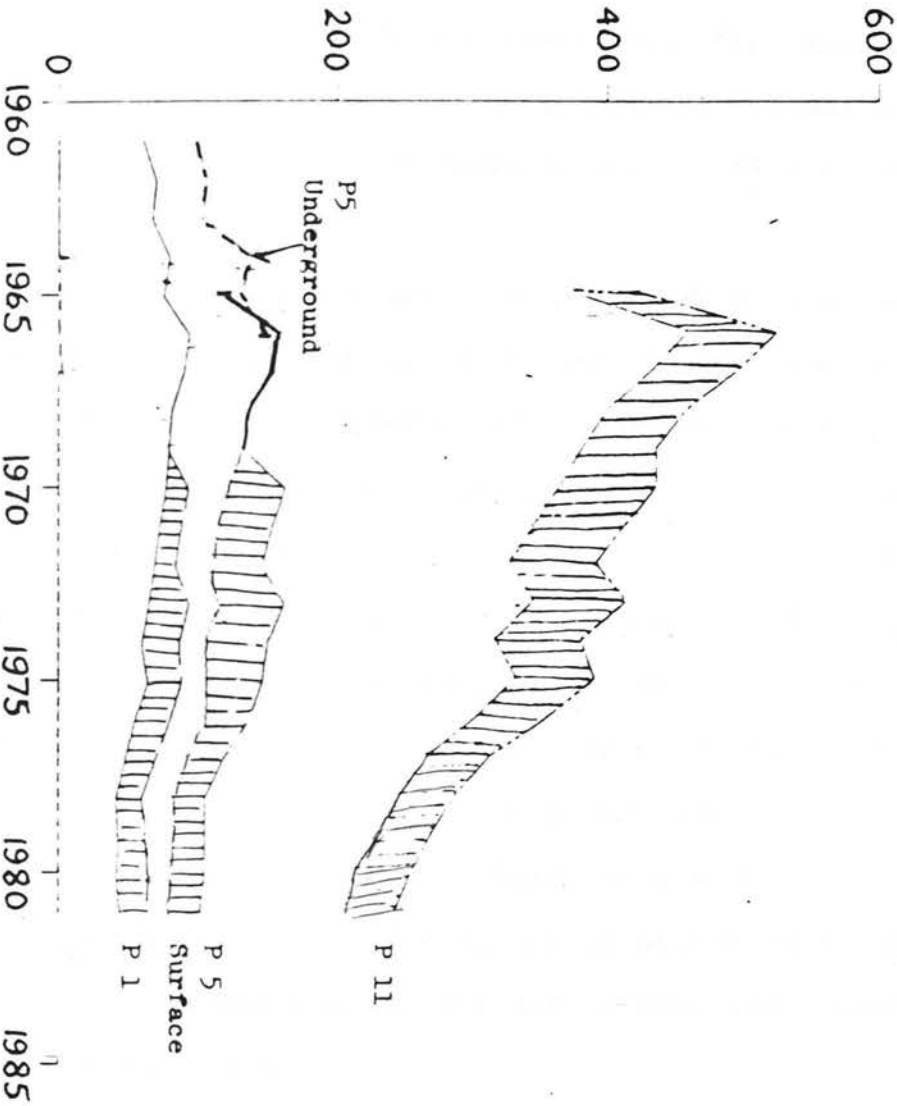


Graph 6.9 Local wage rates in constant terms
K of 1975 per annum

From Table 5.15

LOCAL MINE WORKERS WAGES (DEFLATED)

WAGES



11 AFS

11 AFS

companies had quoted this finding in their submission to the Brown Commission, but the latter argued that it was not "challenging the economic reasoning on which the recommendations of the Seers Report (was) based"^{36/} but that "weighing in the balance the importance of the industry on which the development of Zambia ultimately depends, (it) felt justified in recommending, as part of a new agreement, a general increase in wages which might otherwise be regarded as excessive in terms of the growth rate of the economy as a whole"^{37/}.

After the Brown award, there was industrial peace on the Copperbelt, until after the end of private ownership, and the next wage award was only given four years later in November 1970. To this extent, then, it can be justified. What would have happened if such an increase had not been awarded is, of course, impossible to judge. The effects on labour costs are, though, clear - they rose substantially as we saw earlier. Moreover, the Seers Report was apparently correct in arguing that Zambia could not afford such wage increases. As the wage rates deflated by the relevant consumer price indices that are given in Table 5.15 and Graph 6.9 indicate, real wage rates reached their highest point in 1966, at a level about 50 per cent higher than in 1961, but have fallen since then. By the end of private ownership, real wages were, though, still higher than in 1961, but at about their levels of 1964, at the time of the Seers Report.

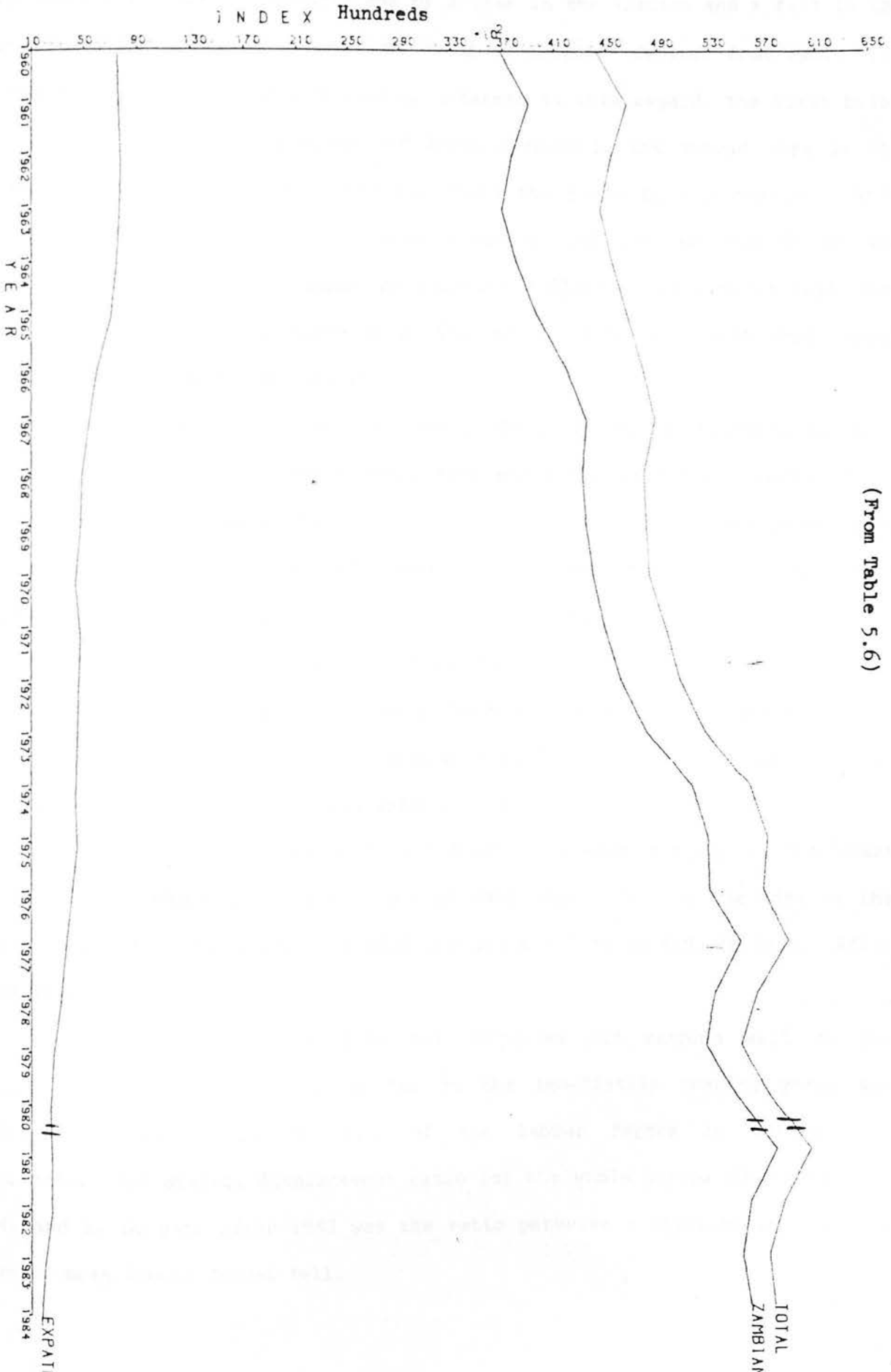
6.4.3 The progress of Zambianization

In the context of labour relations, reference must be made to the progress of Zambianization in the industry. Graph 6.10 shows the number of workers in the industry, divided into expatriates and Zambians, and comes from Table 5.6.

^{36/} Brown Commission, op. cit., page 46.

^{37/} ibid. page 46.

Graph 6.10 The Size of the Labour Force
(From Table 5.6)



|| = Break in series

The overall picture was clearly one of a rise in the Zambian and a fall in the expatriate labour force. Table 6.2, which is directly derived from Table 5.6, gives three columns which are also of interest in this regard, the first being the yearly change in the number of local employees, the second that in the number of expatriate workers and the third the ratio of the changes. This latter is expressed with the sign reversed and can be viewed as the displacement ratio: the number of Zambians replacing every expatriate that left. This ratio should give us an idea of the efficiency with which local labour replaced expatriate labour.

It can be seen that in only one year, 1962, was the relationship perverse - i.e., that the local labour force fell while the expatriate labour force grew. In the seven years in which the two labour strengths moved in the same direction, four were doubly efficient in that not only did the expatriate labour force fall, but so did the local labour force.

Looking at the pre-nationalization period, it can be seen that the greatest increase in the local labour force took place in the years 1964 to 1967 when the increase, of 6565 workers, roughly equalled the total increase in the local labour force between 1960 and 1969.

The size of the expatriate labour force fell most sharply in the years 1964 to 1968, which saw a total loss of 2831 jobs. In 1968 the size of the expatriate labour force stood at 4845 and was still to be 4495 in 1975. After that year it fell rapidly.

The figures, then, show that the companies did respond well to the realities of Independence in so far as the immediately ensuing years saw substantial changes in the size of the labour forces in the desired direction. The average displacement ratio for the whole period 1960-1969, was 2.4, and in no year after 1963 was the ratio perverse - although in 1968 the size of both labour forces fell.

Table 6.2 Changes in Labour strengths at the Zambian mines and the displacement ratios

	Change in the Zambian labour force	Change in the expatriate labour force	Ratio of changes (negative)
1961	2230	113	-19.7
1962	-1355	139	9.7 ^{a/}
1963	- 733	-104	-7.1 ^{b/}
1964	1149	-221	5.2
1965	1580	-420	3.8
1966	2274	-1054	2.2
1967	1562	-603	2.6
1968	-315	-533	-0.6 ^{b/}
1969	302	-118	2.6
1970	594	-352	1.7
1971	903	376	-2.4
1972	1248	-151	8.3
1973	2042	-95	21.5
1974	3449	-113	30.5
1975	1256	103	-12.2
1976	90	-435	-0.2
1977	2364	-451	5.2
1978	-2009	-364	-5.5 ^{b/}
1979	-606	-551	-1.1 ^{b/}
1980	2427	-209	11.6
1981	263	-82	3.2
1982	-1984	-24	-82.7 ^{b/}
1983	-579	-540	-1.1 ^{b/}
1984	672	-244	2.8
Memorandum item			
Total change 1960-1980	18452	-5043	3.7
1960-1969	6694	-2801	2.4
1970-1980	11758	-2242	5.2
1970-1984	10130	-3132	3.2

Source: As for Table 5.6.

Notes: a/ Years where the local labour force fell and the expatriate labour force rose.

b/ Years where the numbers of local and expatriate workers both fell.

6.5 The performance of investment

6.5.1 The change in investment expenditure as given in the companies' reports

The performance of investment was given in Tables 5.16 to 5.23. From tables 5.16 and 5.17, reproduced as graphs 6.11 and 6.12, it can be seen that the net capital stocks of both groups expanded from 1959 to 1969. Tables 5.18 and 5.19, reproduced as graphs 6.13 and 6.14, show that, in nominal terms, this expansion was quite uneven. In the case of Roan Selection Trust, gross and net investment expenditure fell sharply from 1965 to 1968, whilst for the Zambian Anglo American group net investment was weak in the years 1964 to 1966. To this extent there was a post-Independence fall in investment.

The tables and graphs do show that the picture is not unambiguous. For instance, the Zambian Anglo American group's net investment, even in nominal terms, fell sharply after 1963, but, as can be seen from Table 5.21 and graph 6.14, this was largely caused by an increase in the provision for replacements, the figures for gross expenditure were considerably higher in 1967 and 1968 than in 1963. Moreover, the fall in expenditure on replacements in 1969 meant that a relatively small increase in gross expenditure looked like a very sharp increase in net investment.

6.5.2 Problems in using a suitable deflator to arrive at real investment

Another problem with the investment picture is that of choosing a suitable deflator to arrive at figures for real investment. One way to do this is to deflate the capital stock of the companies by the same price index - whether the GDP deflator or some index of the price of investment goods. In one study, the current value of the capital stock was indeed deflated by the implicit GDP deflator adjusted for changes in the terms of trade^{38/}.

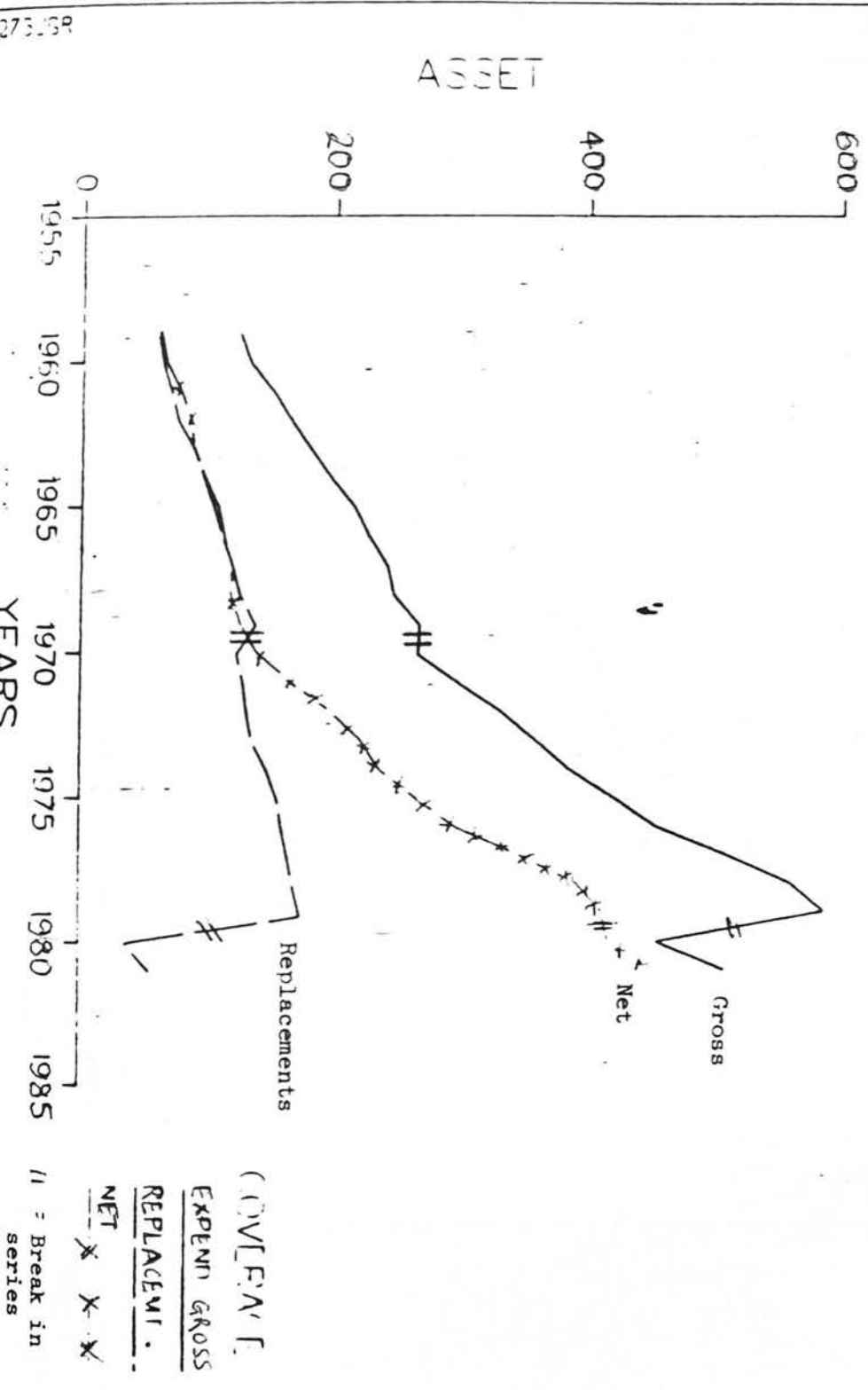
^{38/} DANIEL, P. Africanisation, Nationalisation and Inequality, Cambridge, Cambridge University Press 1979, pages 87 and 182.

Graph 6.11

RST/RCM Accumulated capital expenditure
in nominal terms, 1959-81 (K million)

(From Table 5.16)

ROAN SELECT TRUST/ROAN CONSOLIDATED MINES

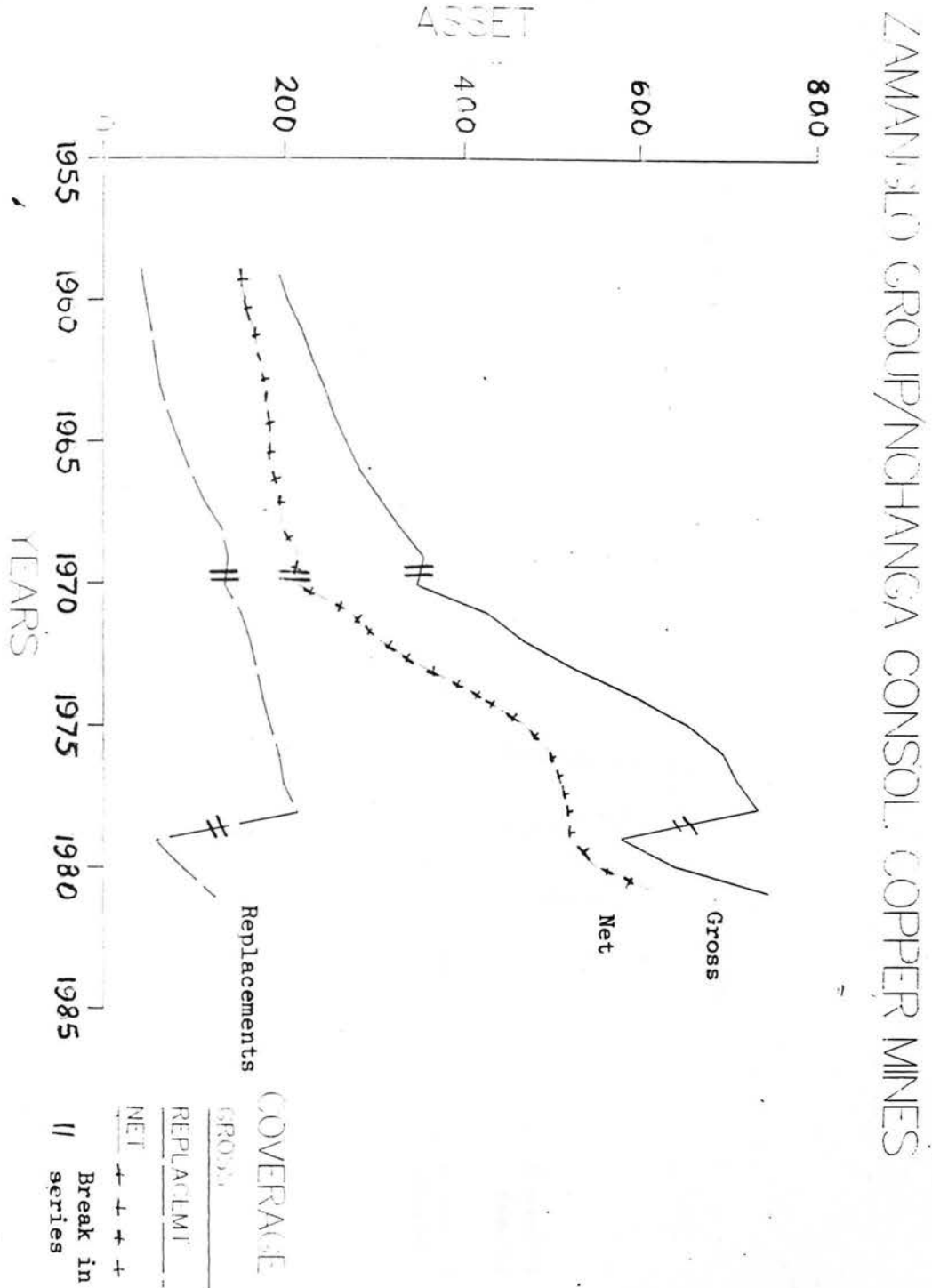


27336R

Graph 6.12

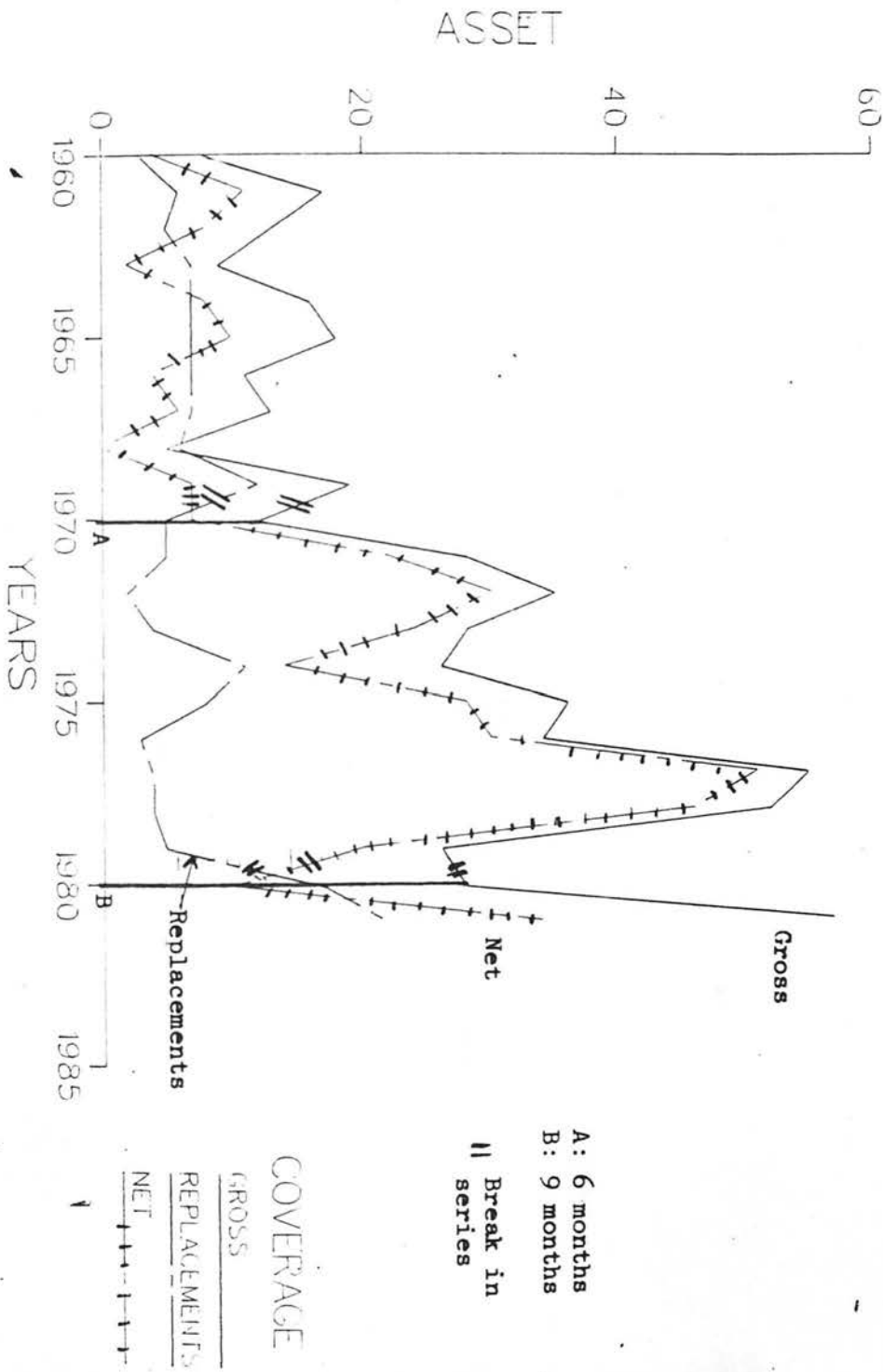
Zamanglo/NCCM: Accumulated capital expenditure
in nominal terms, 1959-1981, (K million)

From Table 5.17



Graph 6.13 RST/RCM Nominal investment expenditure
1960-1981 (K million)
From Table 5.18

ROAN SEL. TRUST/ROAN CONS. MINES



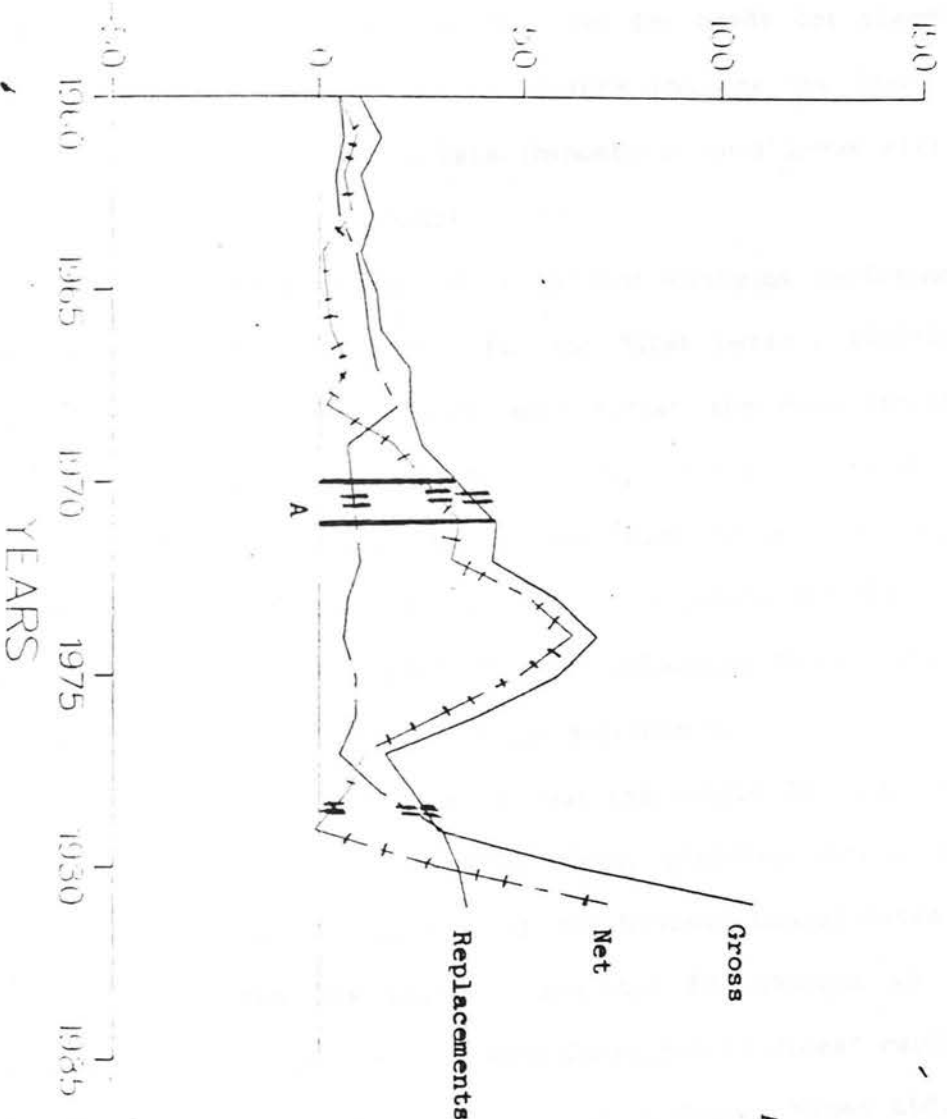
Graph 6.14

Zamanglo/NCCM: Nominal investment expenditure
1960-1981, (K million)

From Table 5.19

ZAMANGLO GR./NCHANGA CONSOL. COPPER MINES

ASSET



A: No figure given
for 1970, figure
for 1971 is for
15 months.

|| Break in
series

COVERABLE

GROSS
NET
REPLACEMENTS

To show the difference that the use of various deflators can make, we have deflated in Table 6.3 the total for net fixed assets of the Roan Selection Trust/Roan Consolidated Mines and Zamanglo/Nchanga Consolidated Copper Mines groups by the GDP deflator, this deflator adjusted for changes in the terms of trade after 1964 and by the wholesale price index for goods for fixed central formation for the period 1966 to 1981 and before that by the index for the wholesale prices of all building materials (henceforth this index will be called that of the price of investment goods).

The first very obvious fact is that enormous difference result from the use of different indicators. For the first period, 1960-1969, the index for the price of investment goods gave almost the same results as did the GDP deflator, adjusted for changes in the terms of trade, and showed Roan Selection Trust's capital stock increasing by over 40 per cent and Zambian Anglo American's by over 6 per cent. The simple GDP deflator, though, showed a fall of about 4 per cent in Roan Selection Trust's capital stock and of almost 30 per cent in Zambian Anglo American's.

For the post-1970 period, it was the simple GDP deflator which showed the figures in their most favourable light, yielding increases of 43 and 15 per cent for Roan Consolidated Mines and Nchanga Consolidated Copper Mines Ltd. respectively. The GDP deflator adjusted for changes in the terms of trade produced a slight increase in Roan Consolidated Mines' capital stock and an 18 per cent decline in Nchanga Consolidated Copper Mines Ltd.'s. The index for the price of investment goods painted the most depressing picture -- the capital stock of each of the two groups fell by over 40 and 50 per cent respectively.

For the sake of comparison, Roan Selection Trust's copper production in 1968/69 was 51 per cent higher than in 1959/60 and Roan Consolidated Mines' production in 1980/81 68 per cent that of 1969/70, 92 per cent that of

Table 6.3 Net fixed assets of the two groups,
deflated by different indices

Year ^{a/}	<u>RST/RCM Group:</u>			<u>Zamanglo/NCCM</u>		
	Wholesale Index ^{a/}	GDP ^{b/}	GDP adj ^{c/}	Wholesale ^{a/} Index	GDP ^{b/}	GDP adj ^{c/}
1960	99.0	110.5	103.8	226.4	252.8	237.6
1961	114.9	134.4	124.7	239.0	279.7	259.4
1962	126.5	146.9	138.1	247.3	287.0	269.9
1963	128.0	147.3	138.4	255.4	293.9	276.2
1964	134.0	157.2	147.8	245.9	288.5	271.1
1965	139.9	158.8	149.2	235.2	267.0	251.0
1966	135.2	133.1	148.2	221.8	218.3	243.1
1967	135.8	130.3	144.0	220.5	211.6	233.8
1968	134.3	119.7	133.8	222.4	198.2	221.6
1969	141.4	106.4	150.3	240.1	180.6	255.1
1970 ^{a/}	152.4 ^{d/}	130.8 ^{d/}	150.5 ^{d/}	259.4	222.7	256.2
1971	166.7	166.7	166.7	273.2	273.2	273.2
1972	180.5	190.3	186.9	279.1	296.3	289.1
1973	189.3	177.9	198.7	304.7	286.4	319.9
1974	177.9	170.2	183.0	315.9	302.1	324.9
1975	163.9	222.2	188.0	290.7	394.2	333.5
1976	137.7	218.7	177.0	233.0	370.1	299.5
1977	127.6	234.3	183.4	188.2	345.5	270.5
1978	112.3	240.1	186.5	148.1	316.6)	245.9)
1978	-	-	-	149.0	318.5)	247.4)
1979	100.3	195.6	169.6	126.1	245.9	213.3
1979	99.1	193.3	167.7	-	-	-
1980	90.9	178.0	155.2	119.1	233.2	203.4
1981	89.5	187.5	153.9	122.3	256.4	210.4
Memorandum (percentages)						
1969/1960	142.8	96.3	144.8	106.1	71.4	107.4
1981/1970	58.7	143.3	102.3	47.1	115.1	82.1

^{a/} Wholesale price index of goods for fixed capital formation 1966-1981, and the wholesale price index for all building materials 1960-1965.

^{b/} GDP deflator, unadjusted for changes in the terms of trade.

^{c/} GDP deflator, unadjusted for changes in the terms of trade 1960-1964, adjusted for changes in the terms of trade 1965-1981.

^{d/} June 30th (corresponding to K140.5 in Table 5.16)

Source: As for Tables 5.16 and 5.17.

1970/71, the year of the Mufulira disaster. Zambia Anglo American's production increased by 8 per cent between 1959/60 and 1968/69, and Nchanga Consolidated Copper Mines' fell by 11.1 per cent between 1971/72 and 1980/81.^{39/}

6.5.3 A measure of the net capital stock in real terms

As mentioned earlier, though, in Chapter 5.5.3, deflating any figure for the companies' assets by any deflator presents problems simply because of the fact that these assets were not revalued each year to take account of price changes. Increases in net fixed assets showed increases in their earning, i.e., productive capacity. If the assets' productive capacity had remained the same, then the figure for net fixed assets should not have moved.

For this reason, to construct figures for the companies' net fixed assets in real terms, we have taken in Table 6.4 the nominal figures for 1959 as the base and have increased or decreased them by the annual figures for net investment, deflated by the price index for investment goods.

As the investment goods' index rose more quickly than did the GDP deflators after 1970 we have also given in brackets the figures for the capital stock using the GDP deflator, adjusted for changes in the terms of trade. It can be seen that very little difference would have resulted if this index, rather than the investment goods' index had been used before 1970, but that this index does

^{39/} Even if 4/5 of the production for the financial year ending on March 31st 1971 were given as the figure for 1970 (i.e. 395.9 thousand tonnes) production could still have fallen by 10 per cent.

Table 6.4 The net^{a/} capital stock of the two mining groups (K million)

	RST/RCM		Zamanglo/NCCM	
	Mining Properties Only	Total	Without Broken Hill	With Broken Hill
1959	63.78	63.78	134.22	150.66
1960	68.40	68.40	139.08	156.50
1961	76.78	79.52	141.71	165.53
1962	72.44	87.79	146.56	171.71
1963	75.05	90.17	154.77	179.93
1964	82.27	98.53	156.45	181.61
1965	90.41	107.77	158.66	183.82
1966	92.70	111.57	160.93	186.37
1967	93.25	116.24	167.09	192.37
1968	95.61	115.53	170.17	194.41
1969	101.52	121.54	185.04	208.35
			199.08 ^{b/}	222.39 ^{b/c/}
1970	(128.48)	127.17	(223.75) ^{b/}	222.39 ^{b/c/}
1971	(143.33)	142.76	(246.22)	245.97
1972	(162.47)	162.14	(266.22)	266.23
1973	(176.77)	176.43	(296.66)	296.64
1974	(184.27)	184.08	(328.35)	329.17
1975	(197.50)	196.18	(351.94)	350.55
1976	(209.58)	206.04	(363.84)	360.27
1977	(227.40)	219.05	(367.71)	363.09
1978	(242.06)	228.31	(370.14)	364.62
1978	-	-	(371.08)	365.22
1979	(247.59)	231.73	(370.71)	364.99
1979	(246.30)	230.94	-	-
1980	(248.78)	232.47	(377.78)	379.10
1981	(256.59)	237.23	(393.78)	379.10
Memorandum items (percentages)				
1969/1960	159.2	190.6	137.9	138.3
1981/1970		186.5		170.5
1981/1970		(199.7)		(176.0)

^{a/} For an explanation of the deflator, see Chapter 6.5.3. The figures in brackets are those for when the GDP deflator, adjusted for changes in the terms of trade, is used.

^{b/} As of 1st January 1970.

^{c/} The previous figure for the copper companies and Broken Hill, K208.35 million, has been augmented by the increase in the copper companies' fixed assets, of K14.04, derived from the previous column, in order to reach the total for 1st January 1970.

Source: As for Tables 5.16, 5.17.

paint a more favourable picture of the capital stock after 1970 and, in particular, after 1976.

Table 6.4 does show that the capital stock of both groups increased substantially between 1960 and 1969 - by 59 per cent in the case of the mining priorities of Roan Selection Trust and almost 91 per cent in the Trust's mining and exploration companies. With or without Broken Hill, the Zambian Anglo-American group's net fixed assets increased by almost 40 per cent.

6.5.4 Some pre-nationalization investment projects

These increases in the capital stock did reflect decisions to invest in capacity. In the case of the Roan Selection Trust group, after the Mufulira West expansion programme had been completed in 1962, it announced that it was going to open up the Chambishi deposit as its only open-pit mine^{40/} at a cost of £7.5 million. The open pit would have an ultimate depth of 600 feet^{41/} and would remove 15 million short tons of ore. Deeper sections of the ore body were to be removed by underground methods. Full production was expected to be 25,000 tons of copper per annum and to start in 1967.

Another deposit that the Trust decided to develop was Kalengwa. Its discovery had been announced in 1964 and, in 1966, the decision to go ahead with its exploitation was announced.^{42/} It was a small but high grade deposit and so at a capital cost of only £1.5 million, a production of 12,800 tons of copper a year, starting in 1968 and extending for only six years, was expected.

^{40/} Announcement by Chambishi Mines Ltd. on 21st May 1962 and Comments made to the Press on 21st May 1962, by Sir Ronald L. Prain, mimeographed RST documents.

^{41/} "Chambishi - Copperbelt's new mine recovers first copper from oxide ores", Mining World, June 1965, page 30.

^{42/} RST Group of Companies "Statement by the Chairman, Sir Ronald L. Prain OBE" to accompany Annual Report 1966.

After the Zambian mines returned to full production in June 1967, after eight months' reductions caused by fuel shortages, the companies announced plans to expand capacity at an estimated cost, in 1967/68, of £30 million. Nchanga alone planned to spend £10 million, as opposed to £5.6 million in 1966/67, to boost monthly ore production from 540,000 to 780,000 short tons and to increase smelter capacity to enable production to be raised from 190,000 tonnes of copper a year to 254,000 tonnes^{43/}.

6.5.5 Investment as shown by the development work completed

We mentioned in Chapter 5.5.4 that the amount of physical work being undertaken at the mines could be gauged from the development work undertaken. Tables 5.21 and 5.22 gave figures for the various mines. The totals for the two groups are given in Graph 6.15.

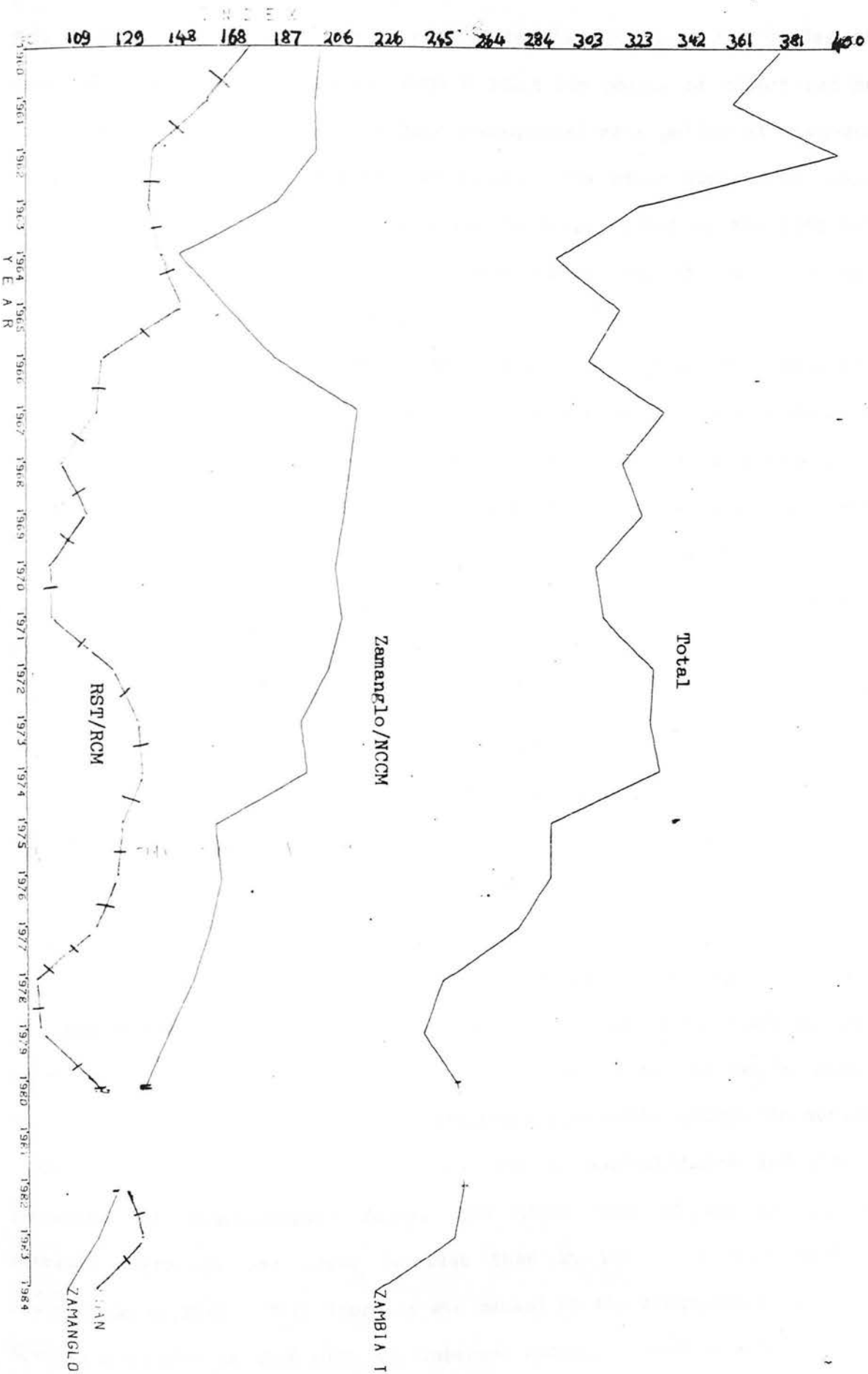
The figures for Chibuluma showed a fall in the years after 1963 with there being a recovery from 1966, the year of a major inflow of water, as the mine was rehabilitated. The Luanshya mine showed clear signs of exhaustion in the 1960s and development work reached its maximum in 1965. Mufulira's expansion was underway in the early 1960s and after its completion, in 1962, development did fall off. For the Roan Selection Trust group as a whole, the development work completed in 1969, of 114.6 thousand metres, was only 65 per cent of that in 1960 and 80 per cent that of 1964, the year of Independence.

To this extent, then, it can be said that there was a fall-off in physical work on the Trust's mines. Two explanations suggest themselves - the first being that the companies were ignoring the long-term future of their properties and were simply pulling as much ore as possible out of the ground.

^{43/} Wall Street Journal, August 24, 1967, page 24 and Nchanga Consolidated Copper Mines Ltd. "Review by the Chairman, Mr. H. J. Oppenheimer" to accompany Annual Report 1967.

Graph 6.15
Underground development work in Zambia
(Thousand metres)

From Tables 5.22 and 5.23



This argument would appear to be refuted by the fact that the grades of ore mined dropped over time, whereas such a short run policy of output and profit maximization would normally have been accompanied by a policy of high-grading -- i.e., extracting only the high grade ore. The other explanation could be the difficulties in maintaining work on the mines caused by the aftermath of Rhodesia's Unilateral Declaration of Independence and the problems arising from the transition to Independence.

The difficulty in reaching firm conclusions from the figures for development work is well illustrated by the figures for the Zambian Anglo American mines of which only Konkola was a wholly underground mine. Development work for the group's mines was at its lowest point in 1964 the year of Independence, at 149 thousand metres, after which there was an increase. In 1969 development work completed, of 210 thousand metres was 4 per cent greater than in 1960. For Zambia as a whole, development work completed in 1969, 324.8 thousand metres, was 86 per cent that of 1960, but 11 per cent greater than that of 1964. The figures for the country as a whole do not, then, lend support to the contention that after Independence the companies neglected their properties, which might have been suggested by the figures for the Roan Selection Trust's mines.

6.6 Financing investment before nationalization

Investment in capacity at the mines during the last years of private ownership was primarily financed by internal resources. As can be seen from Table 5.30, the total debts of the companies were quite manageable during the 1960s. Those of Roan Selection Trust fell in nominal terms and also as a percentage of shareholders' funds. The total debt of the Zambian Anglo American companies was lower in 1968 than in 1960, but then doubled to K36 million in 1969. This increase was caused by the arrangements the Nchanga Company concluded in 1968 with the Japanese companies, Mitsui and Co. Ltd. and

Mitsubishi Shoji Kaisha Ltd., its principal customers, to receive a loan of \$42 million and a credit facility of \$28 million for the purchase of Japanese plant and equipment to help it expand its mining and milling treatment rate. The Zambian Anglo American companies agreed in return for the loan to supply 100,000 tonnes of copper per annum over a ten-year period to the two firms and, as a guarantee of the loan's repayment, Nchanga pledged its holding of the Bancroft company's preference and ordinary shares^{44/}. Even with this loan, the ratio of the Zambian Anglo American's group's total borrowings to its shareholders funds was less than 13 per cent. The figures for share capital and share premiums in Tables 5.24, 5.26 and 5.28 show that important issues of shares were not made during the 1960s. The increase in Roan Selection Trust's share capital in 1969 was achieved through the capitalization of the company's capital and general reserves and part of the share premium account and by a bonus issue of shares^{45/} -- it did not represent a fresh injection of capital.

6.7 Exploration begun before 1970

In Table 5.31 we gave figures for the amounts spent on exploration campaigns that began before 1970. Of the total of K62.9 million, more than half, K37.8 million was accounted for by exploration started by the two major groups before 1970 but which continued after nationalization. Another K3.6 million was accounted for by programmes by the two groups that ended before 1970 (Kasempa Minerals, Barotseland Exploration and Kadola Mines Ltd.)

The main work of exploration before 1970 was, then, undertaken by the mining companies themselves, which was hardly surprising as exploration was a form of investment for their future. Indeed, most mining companies will devote a certain amount of their income to exploration, and indeed a figure of

^{44/} Mining Journal, April 19th, 1968 pages 307-308.

^{45/} Roan Selection Trust Ltd. Annual Report 1969, page 6.

one per cent of revenue was given in 1969 as the amount a major mining company should spend on exploration.^{46/} In Zambia, the two groups had the added advantage of being able to pick the most promising areas for their own prospecting and hold them as exclusive prospecting concessions. We will now outline briefly their work of exploration.

6.7.1 Roan Selection Trust's Work of Exploration

After the Second World War, the Roan Selection Trust tied up all the ground underlain by strata of the Lower Roan group of rocks with a view to examining it by modern geophysical techniques in the hope of locating hidden copper concentrations.

Three of the companies it set up - Mwinilunga, Kadola and Chisangwa - were to explore areas that were continuations to the west of the Copperbelt. The fourth company, the Luapala Company, was to investigate an area running alongside the Congo border in the eastern part of the country. Pre-war exploration there had revealed copper, lead and zinc in the Fort Rosebery district and copper on the east shore of Lake Mkeru^{47/}, and so further exploration appeared justified.

The areas to be explored covered a total of 35,000 square miles in the most promising mineral areas of the country and, in the early years, the Trust was optimistic of success in the large campaign of exploration it was undertaking^{48/}. Unfortunately, this early optimism was to be largely disappointed.

^{46/} Kruger, F. G. "Mining - a Business for Professionals Only" Mining Engineering September 1969 page 87.

^{47/} Cf. GUERNSEY, T. D. A Prospector's Guide to Mineral Occurrences in Northern Rhodesia, Salisbury, BSA Company, 1951, and THIEME, H.G. "Explanation of Degree Sheet 1128, parts of N.W. Quarter and N.E. Quarter", Report No. 26 of the Geological Survey of Zambia, Lusaka, 1970.

^{48/} Cf. PRAIN, Sir R. L. "The Northern Rhodesian Copperbelt", New Commonwealth, December 1953. Re-printed in Selected Papers, Volume I, 1953-1957, London, Rhodesian Selection Trust, 1958.

The Luapala Company was dissolved in 1961 and the Trust did not spend any more time in the area. The only mineral that proved to be worth mining in the area was manganese which was extracted at a profit by smaller companies between 1953 and 1961. However, it was not worth-while for the large copper companies to use their geological staff in investigating such deposits when they could have been put to better use in searching for copper deposits or in examining existing copper mines with a view to increasing known reserves.

The Trust was equally unsuccessful in the 4,000 square miles of the Kadola company. In 1969, after 16 years of unfruitful work, the company was wound up and the area abandoned. The failure here was more significant than that at Luapala because of its proximity to the Copperbelt.

The Trust had more success in the Chisangwa and Mwinilunga areas where, apart from the Copperbelt and Kapiri Mposhi and Mpika, its 60 professionally qualified geologists, geophysicists and geochemists and 300 other employees^{49/} had concentrated their efforts by 1969.^{50/}

In the Mwinilunga area, two deposits, Kalengwa and Lumwana, were discovered. The former was found after aerial photography had, in 1956, identified clearings - possibly caused by the presence of copper in the soil - in the area. The most significant vegetation was a narrow-leaved mauve-white flower which grew in abundance and which, on examination, was seen to contain 1,000 to 4,500 parts per million of copper, whereas an average plant contains 20. Because of the area's inaccessibility, it was only after a track had been cut in 1963 that a methodical examination, using geochemical methods, trenching and, finally, drilling revealed the small, but high grade,

^{49/} Roan Selection Trust Appendices to Explanatory Statement of Roan Selection Trust for Meetings of Share-holders to be held on 6 August 1970, 30 June 1970, page I-1.

^{50/} Vide LEE-POTTER, J. "Prospecting by RST" Horizon, September 1969, Figure IV, page 20.

deposit^{51/}. Its discovery was announced in 1964 together with that of Lumwana, located in 1960 by drainage reconnaissance which had come across brightly coloured copper-stained rocks on the banks of the Lumwana river^{52/}.

6.7.2 The exploration conducted by the Zambian Anglo American Group

The Zambian Anglo American group's exploration campaign was different from that of Roan Selection Trust in starting later, in being spread over a larger area and in ultimately being less successful. The Zambian Anglo American group had already examined the areas underlain by the Loan Roan group strata before the Second World War and was sceptical of the kind of re-examination undertaken by the Roan Selection Trust Group after the war. Their chief geologist, Dr. Bancroft, thought that his own work had been "sufficiently intensive and thorough to ensure that no further copper discoveries would be made" and that only intensive diamond drilling rather than electrical geophysical methods would prove successful.^{53/}

The most important of Zambian Anglo-American's exploration companies, Chartered Exploration Ltd., was formed in June 1955 by the Chartered Company, in which the Anglo American Corporation had a substantial interest. The Chartered Company had every incentive to find new mines as, in 1950, its rights to mineral royalties had been limited to 1986. Zambian Anglo American participated in the new company which had been formed to re-evaluate, by means of the most modern prospecting methods, the areas that it had investigated before the war using only visual aids and traverses on foot.

51/ Accounts of the discovery of Kalengwa are found in ELLIS and MCGREGOR op. cit., LITTLEFORD, D.H. and MAYCOCK, A.R. "Kalengwa Copper Mine is Zambia's Mighty Midget" World Mining (U.S. Edition) June 1972, pages 32-33 and World Mining (U.S. Edition) September 1966, page 39.

52/ Information on the Lumwana Deposit is from MCGREGOR, J.A. The Lumwana Copper Deposit in Zambia, Ph.D. Thesis, Rhodes University, South Africa, 1964.

53/ FREEMAN, P.V., History of Mining and Exploration in Zambia, undated mimeographed document supplied by Zambia Appointments Ltd.

The prospecting operations followed a logical pattern. In the first place, existing data - reports, maps and aerial photos - were examined and various portions of the 120,000 square miles^{54/} over which the company had obtained concessions were chosen for airborne surveys. Another method for surveying large areas was geochemical stream sediment sampling which was perfected and refined as work progressed. Finally, reconnaissance geochemical soil sampling was used to choose areas for closer study.

After analyzing the results of this work, target areas were chosen and intensive investigation by geochemical and geophysical surveys and by pitting, trenching, crosscutting and, finally, drilling followed. The search was not just for copper as spectrographic analysis was made for 15 to 24 elements.

Naturally, not every trace of mineralization was followed up but, as experience in using the new methods of exploration was built up, certain areas covered by earlier, less refined methods were re-appraised. In the event, after dropping ground in 1960, 1962 and 1964, the concessions held by the company were reduced to approximately 28,000 square miles in 1965^{55/}, and, after the passage of the Mines and Minerals Act of 1969, further ground was dropped, resulting in 13 concession areas totalling 4,500 square miles being retained.^{56/}

No exploration effort is totally wasted as it always produces new information which can be used by later explorers,^{57/} if only to let them know where not to prospect, but the results of Chartered Exploration Ltd.'s work were not encouraging. In spite of the expenditure, by 1975, of over

^{54/} Rhodesian Anglo American Annual Report, 1961, page 8.

^{55/} Zambian Anglo American Ltd. Annual Report, 1965, page 9.

^{56/} Zambian Anglo American Ltd. Annual Report, 1970, page 14.

^{57/} In fact, the two groups made available to outside interests information on the areas they relinquished in 1970, and answered their inquiries in detail (DRYSDALL, A. "Prospecting and Mining Activity 1895-1970" in BOSTOCK, M. and HARVEY, C. Economic Independence and Zambian Copper, New York, Praeger 1972, page 82).

K 15 million on field operations and the employment, at its peak, of 77 professionally qualified personnel and 500 other employees, only a few small finds were made, such as a small gypsum deposit near Monze which was operated at a loss from 1966 to 1969. They were turned over to Mindeco Small Mines Ltd., a subsidiary of Mindeco, the Zambian Government's mining agency. In 1975, the company, renamed Zamanglo Exploration Ltd., had reduced its exploratory activities to such an extent as to make it no longer economical to maintain its extensive Lusaka headquarters. Accordingly, Mindeco was allowed to acquire a large part of them.^{58/}

Chartered Exploration Ltd.'s personnel also worked for another smaller company, Kasempa Minerals Ltd., which was incorporated in 1957 and liquidated in 1967, after nothing of value had been found in the 1,800 square mile concession it had near Kasempa.^{59/}

The smallest Zamanglo exploration company, Kalindini Exploration Ltd., formed in October 1957, operated within the Copperbelt and investigated nine exclusive prospecting areas totalling 293 square miles after an airborne survey, completed in 1956 and using a magnetometer and scintillation counter, had revealed anomalies in these areas.

The company was financed by Rhokana and Nchanga, which contributed 45 per cent each of its capital, the Chartered Company contributing the other 10 per cent. It was liquidated in March 1963 and five areas of interest were converted to special grants.^{60/} By 1970, though, only one, Fitula, had been found to be worth retaining. The result of Kalindini Exploration's work,

^{58/} Standard Chartered Review, April 1975, pages 10-11.

^{59/} Rhodesian (Zambian) Anglo-American Ltd. Annual Report, 1962, page 27; 1963, page 24; 1967, page 4.

^{60/} Rhodesian (Zambian) Anglo-American Ltd. Annual Report, 1963, page 24.

then, was the addition of 4 million tons of ore to Nchanga's reserves, no greater than the yearly additions that have characterized the growth of the mine's gross reserves.

In sum, although much effort was put into exploration by the Zambian Anglo American group and many different mineral deposits examined, it did not have the success of the Roan Selection Trust group in discovering totally new deposits.

As Table 5.31 showed, the two copper groups were not the only private or public bodies to undertake exploration in Zambia after the war. Other private firms, in particular Minerals Search of Africa, part of the Rio Tinto group, Frobishers and de Beers, also conducted prospecting operations. However, nothing important has been found by any of these companies yet.

6.7.3 The work of the Geological Survey

The public body to undertake exploration was the Geological Survey Department.^{61/} Founded in 1950, it was one of the last Colonial Geological Surveys set up, probably reflecting the great role the copper companies and the Chartered Company had played in geological mapping and also the British Government's limited interest in the country's development.

The initial establishment was 1 chief geologist and 3 geologists and, by the time of Independence in 1964, had grown to 18 professionals. Post-Independence growth was rapid, the establishment reaching 38 professionals in 1966, and 41 in 1971.

^{61/} For the history of the Geological Survey Department vide DIXEY, F. "Colonial Geological Surveys, 1947-1956", Bulletin Supplement No. 2 to Colonial Geology and Mineral Resources, London, HMSO, 1957, pages 44-48, DRYSDALL, A.R. "The Geological Survey of Zambia" Records of Geological Survey, Volume XII, Lusaka, 1972, and "The Geological Survey of Zambia: its role in the social and economic development of the country" Occasional Paper No. 70 of the Geological Survey of Zambia, 1974, and op. cit., pages 62-63.

The Survey's work was intended to complement rather than overlap the field of interest of the mining companies and so, apart from mapping areas that the latter had not concentrated upon, it looked for mineral occurrences of importance to the country's industrial development or to small operators.

In 1962, an Economic Unit was established to perform these functions, and, in 1965, it began an urgent re-assessment of the country's coal resources with favourable results. Coal deposits were opened up in the Zambezi valley, where in fact coal had been outlined in 1907^{62/} and again in 1949-50 by a team organized by Mark C. Malamphy and Company for the Government of Northern Rhodesia.^{63/} What made the search for coal especially urgent after 1965 was the Rhodesian Unilateral Declaration of Independence and the Government's desire to limit the country's reliance on coal supplies from the Wankie colliery in Southern Rhodesia. Coal from Zambia was of a higher cost than Wankie coal and, until the commissioning of a washing plant in 1970, less suitable for use in the smelters.^{64/} In fact, it was even reported that Sinazongwe coal was so rock-like that it actually put smelter fires out.^{65/}

6.7.4 Exploration at the time of nationalization

From the foregoing description of exploration in Zambia until the time of nationalization, it can be seen that the major part of the work was undertaken by the companies themselves. They had been active in the field since the end of the Second World War but as time went on they tended to concentrate their efforts on those areas that were the most promising geologically or where

62/ W.H. REEVE The Geology and Mineral Resources of Northern Rhodesia, Bulletin of Geological Survey of Northern Rhodesia, No. 3, 1963.

63/ Mark C. Malamphy & Co. Ltd. Investigation of the Coal Resources of Northern Rhodesia Summary Report, October 1949 to July 1950 by Miller W. Ellis., 1950.

64/ BOSTOCK M. "The Background to Participation" in BOSTOCK and HARVEY op. cit., page 119.

65/ Information supplied by R. H. Hobson of Zambia Appointments Ltd.

deposits, if found, would be relatively cheap to develop. This in effect meant that by the time of nationalization both groups, but especially the Anglo American Corporation, were concentrating their efforts on the Copperbelt.^{66/}

It could, then, be argued that a fillip was needed to encourage exploration outside the Copperbelt and exploration for other minerals than copper in the country. This could have been provided by opening up the country to new exploration companies. However, it is difficult to come to any conclusion as to whether the work of the existing copper companies could have been bettered. There is no indication that the present writer has seen in the literature that they were anything but energetic and innovative in the work of exploration, that they did not search for all possible economic minerals or that they did not maintain their interest in exploration right up to the time of nationalization. A simple test of the success of their work of exploration would be whether they discovered as much copper as they withdrew from the reserves. In Table 6.5, the published reserves of the Zambian mines are given for the years 1930, 1960, 1969 and 1982. It can be seen that ore reserves, expressed in terms of contained copper, were actually greater in 1960 than in 1930 when production was first getting underway, being 26.5 million tonnes of copper as against 20.26 million tonnes. By 1969, reserves of contained copper had dropped slightly to 25.2 million tonnes. However, all of this fall can be accounted for by the fall in Baluba's reserves caused by technical factors: the deposit was not exploited between 1960 and 1969.

This increase in reserves did, though, come about through additions to known ore bodies and resulted from drilling programmes at existing mines as part of their forward planning, rather than from campaigns of prospecting.

^{66/} DRYSDALL A. in BOSTOCK M. & HARVEY C. op. cit., pages 71-72.

Table 6.5

The Reserves of the Zambian Mines (million tonnes of ore)

	1930	Grade (%)	1960	Grade (%)	1969	Grade (%)	1982	Grade (%)
Roan Antelope	98.0	3.44	85.8	3.04	69.6	2.87	51.0	2.44
Mufulira	105.2	4.41	162.2	3.35	145.5	3.28	103.0	3.05
Chambishi	23.7	3.46	31.8	3.37	29.7	3.08	28.8	2.81
Baluba	19 ^{a/}	3.47	101.6 ^{b/}	2.41	59.7 ^{b/}	2.71	57.9	2.52
Chibuluma	-	-	8.9	4.89	5.8	5.12	7.2	3.71
Kalengwa	-	-	-	-	0.80	13.73	ex	ex
Nkana	112.5	3.85	109.2	3.07	116.3	2.61	110.0	2.32
Nchanga	130.5	4.66	163.3	4.65	225.8	4.02	268.3	3.16
Konkola	-	-	95.2	3.73	84.0	3.49	207.2	3.72
Kansanshi	7.3	4.15	- ^{c/}	- ^{c/}	6.8 ^{d/}	3.44	26.3	3.10
Bwana Mkubwa	2.2	3.94	-	-	5.9 ^{d/}	3.00	0.2	3.40
Total	497.4	4.07	758.0	3.50	749.9	3.36	859.9	3.08
Contained copper	20.26	-	26.49	-	25.16	-	26.47	-

ex = mine exhausted

Source: Company reports, Mining Year Books, various years.

a/ Figures for 1931.

b/ Although the Baluba mine was not exploited between 1960 and 1969 a closer examination of the deposit led to the downward revision of the reserves.

c/ Kansanshi was flooded in 1957 and no figures for reserves (i.e. exploitable ores) were given in 1960.

d/ Figures for 1971.

6.8 Summary: the period before nationalization

From the foregoing analysis, it can be seen that the years before nationalization were ones in which the copper industry had to face many challenges - first of attempting to stabilize the copper market, then of adjusting to Independence and, a year later, to Southern Rhodesia's Unilateral Declaration of Independence. The partial nationalization of 1969 took place at a time when the industry had returned to near-normality after the several shocks it had faced. The companies were at that time planning to spend substantial sums on new capital programmes.

We have examined the industry's performance in many different fields and it would be difficult to say that nationalization was the necessary and obvious solution to a persistent problem in the industry. Perhaps the most conclusive evidence for this is that the nationalization announcement took the industry by surprise^{67/} and was thought by some observers to be a dubious move^{68/}. The press commentary at the time tended to dwell more on tribal tensions, political considerations and opposition to capitalism than on any alleged poor performance of the industry under private ownership. The unexpectedness of its timing does not, though, mean that the 1969 partial nationalization was in no way justified or that no thought had gone into whether or not the decision should be taken. Before the decision was taken, and for some time afterwards, the industry's performance had been criticized and arguments were advanced that nationalization would be beneficial to it.

67/ Cf. PRAIN, Sir Ronald Reflections on an Era Metal Bulletin Books, London 1981, page 176.

68/ Cf. Mining Journal August 15th 1969, page 133.

In the next chapter, we will give the various criticisms raised against the industry. This will show us which aspects of the industry's performance to concentrate on when subsequently analyzing the performance of the industry after nationalization.

Chapter 7

REASONS GIVEN FOR THE NATIONALIZATION OF THE ZAMBIAN COPPER MINING INDUSTRY

In this chapter, we will discuss the economic justifications advanced at the time for the Zambian Government's 51 per cent take-over of the copper mining industry in 1969 and for its subsequent abrogation, in 1973, of the management contracts it signed with the former private owners. We will not be asking whether there was any validity then or later in the justifications it advanced. As we saw in chapter 2, a private company can be seen from a country's point of view to be exploiting too rapidly or too slowly a mineral deposit. To investigate the consequences of a nationalization it is, then, useful to see what the Government hoped to achieve by these measures.

7.1 Zambia not having an independent Ministry of Mines

At the time of Independence and certainly until nationalization, the people who ran and knew all about the workings of the copper industry were the executives of the mining companies. During the period of colonial administration, the companies had been left with a free hand to run the industry. No effort was made to establish an independent Ministry of Mines that could have provided the Government with independent advice. This was perhaps understandable given the colonial administration's generally laissez-faire attitude. At the time of Independence, then, there was no established group of expert advice that the Government could rely upon for its new relationship with the copper industry. Instead, it relied on the advice of imported advisers from outside, who were generally treated with contempt by the mining companies executives,^{1/} and whose advice was often more in the

^{1/} For instance, F. T. Ostrander of Amax thought that the Zambian Government had received a considerable amount of bad advice from "economic carpet baggers" who hang around and peddle their so-called expertise" (Quoted in STOEVEY, W.A. Renegotiations in International Business Transactions, Lexington, Mass., D.C. Heath, 1981, page 72.

form of words in the President's ear than formal documents such as British Parliamentary Papers. There is, then, no large published collection of studies from a Ministry of Mines that would enable us to see the steps leading up to nationalization.

7.2 Reasons given for the 1969 51 per cent nationalization

The decisions to "invite" Roan Selection Trust and Zambian Anglo-American to offer a 51 per cent shareholding in their companies to the Government and later to cancel the management contracts were taken and announced in two speeches by the President of Zambia, Dr. Kenneth Kaunda, without prior discussions with the parties involved. Although it can be argued how much the companies had expected such moves, the announcements did take them by surprise. In the case of the August 1969 speech at Matero, the surprise was such that many journalists thought that pressures on the President were reaching breaking point, with tribally motivated internal dissension, growing unemployment, the failure of his agrarian policies and the recent resignation of the Chief Justice,^{2/} and that nationalization of the mines won him enough political support to ride out the crisis. There was much truth in this assessment, but as The Economist also put it "Nationalization satisfies (Kaunda's) cabinet's fundamental opposition to capitalism".^{3/} The account of these events by Andrew Martin comes to a similar conclusion, that "while short-term political factors must have influenced the decision, it is not necessary to assume that they were the main cause of it".^{4/} Finally it is only necessary to refer back to Dr. Kaunda's party's views of 1962, that "One

^{2/} Cf The Economist July 26th, page 43, and August 16th, page 21.

^{3/} Ibid. August 16th, page 21.

^{4/} MARTIN A. Minding Their Own Business: Zambia's Struggle Against Western Control London, Hutchinson, 1972, page 162.

of the objectives of economic policy is to encourage and attract capital from abroad ... we believe that nationalization of the mines would lead to political and economic upheavals and uncertainties to investors abroad ..."^{5/} to see that Zambia's philosophy concerning foreign investment had changed in the intervening years.

Whilst the 1969 nationalization must be understood in the context of political pressures and a steady drift towards state capitalism, it was nevertheless expected to yield positive benefits to the country.

The President's speech of August 1969, perhaps understandably, did not detail precisely the expected results of nationalization. However, it, together with recommendations of a United Nations survey team in March 1964, and a paper by Michael Faber, a senior economist and Under-Secretary in the Zambian Government, give us a reasonable idea of what was expected from the measures. We will deal with them consecutively.

7.2.1 The Analysis and Recommendation of the Seers Mission

The United Nations study,^{6/} frequently referred to as the Seers Report after its leader, was intended to help the future post-independence Government form its economic policy. From 1953 until the end of 1963, Zambia, known then as Northern Rhodesia, was part of the Central Africa Federation which included Southern Rhodesia (Zimbabwe) and Nyasaland (Malawi). Independence in October

^{5/} Cited by OSTRANDER, F.T. in "The Role of Foreign Capital" in DAVIS, John A. and BAKER, James K. (eds.) Southern Africa in Transition New York, Praeger, 1966, page 348.

^{6/} United Nations Economic Commission for Africa, Food and Agriculture Organization, Economic Survey Mission on the Economic Development of Zambia Ndola, 1964.

1964 thus brought it not only majority government but the freedom to correct its economy from the distortions introduced by a Federation which had largely benefited Southern Rhodesia.^{7/}

The Survey Mission saw that the main target of economic policy should be to increase employment.^{8/} Employment at the mines was not expected to increase significantly because "when a mineral industry, such as copper, reaches a certain size, it does not provide much further employment itself, because of the scope for mechanization."^{9/} The incomes generated in copper were to be used to provide employment by enabling the other sectors of the economy to develop. It would do this by providing increasing revenues for the Government which in turn would increase expenditure on services such as education and on construction, leading, through the multiplier effect, to an expansion of incomes.^{10/} Although the Mission thought that the country's development programme over the following six years, until 1970, would not necessarily rely on any net flow of capital from overseas,^{11/} this was only in the light of rising earnings of foreign exchange from the copper industry.^{12/}

^{7/} Ibid. pages 9-11.

^{8/} Ibid. page 13, paragraph 57.

^{9/} Ibid. page 8, paragraph 15.

^{10/} Ibid. page 14, paragraph 76.

^{11/} Ibid. page 21, paragraph 116.

^{12/} Ibid. page 27, paragraph 2.

However, the Mission stated, and we will quote from the original text at length,^{13/} that "There is no guarantee that capacity will be expanded adequately. The companies may, from their own point of view, have perfectly good reasons for not developing their concessions vigorously; their controlling interests may prefer that profits should be reinvested elsewhere, so as to spread their risks. This is, however, a matter of the nation's vital interests." The Mission argued in favour of an agreed solution in these terms: "The Government could coerce the companies into expanding output. It could adopt a system of taxation that heavily penalized them if they failed to expand. It could be arranged for the exchange control authorities to exercise a strict control over the industry's remittances of dividends and its capital transactions. But there is a great deal to be said for trying to work out copper policy in co-operation, rather than in a running fight ... The main interest of the companies (a safe and growing body of profits) is not incompatible with the chief concern of the Government (to be able to rely on an upward trend in revenue to finance its development plans) ... Antagonism would harm industry and Government, and if relations deteriorated to the point of nationalization, both would suffer."

The Mission's recommendations were, then, for a formal agreement to cover "the period until (say) 1980: ... (1) on the side of the companies, [this] could include the following guarantees: to expand capacity on a certain specified schedule (which would include at least 875 thousand tons for 1970); to aim at 825 thousand tons of output (barring what the insurance companies know as "acts of God"); ...to give the Government all the technical information

^{13/} The quotations are from ibid. pages 27-30.

it requires (where necessary on a confidential basis); to appoint Africans to the higher jobs on an agreed time schedule ...

"The Government, for its part, could guarantee not to nationalize producing companies in these fifteen years, with legal safeguards; not to raise taxes during this period above a specified fraction of profits; and to consult the two groups on any matters that affected them both ...

"The degree of co-operation would be closer and more secure if the Government held an equity interest in the companies with its nominees on the company boards."

The mission suggested that the equity interest could be acquired in lieu of royalty payments or export tax payments. At that time, royalties were actually being paid to a private company, the British South Africa Company, that had been founded by Cecil Rhodes in 1889 and owned the country's mineral rights. As the Mission correctly foresaw, this situation could not last after Independence and indeed the first achievement of the new Government was to gain control over this source of income. Export taxes on copper did not exist in 1964. The Mission envisaged the companies issuing the Government with shares which would yield it dividends about equal to the royalty income. This would help the companies by transferring certain items from "costs" to "share of profits", thus reducing their financial liability. The Mission saw dangers involved in this policy and warned that the Government's "part of the industry's proceeds would become more volatile, although against this disadvantage one must set the fact that it would be able to influence the industry's operations directly."

7.2.2 From the Seers Mission to Mulungushi

In the event, the Government acted on surprisingly few of the recommendations of the Seers Report in so far as it affected mining. The Mission had recommended the creation of a separate Ministry of Mines that would be able to give the Government facts and advice and then enable it to play a more active role in the mining sector and to come to the kind of agreement it had envisaged between itself and the companies. It was very slow to adopt this suggestion.^{14/} The Government also ruled out any idea of taking a shareholding in the companies,^{15/} and no such agreement as the Seers Mission had envisaged was reached. Some of the Mission's recommendations were accepted. In particular, an export tax was introduced in 1966, but no drastic overhaul of the taxation system was undertaken.

In April 1968, the President started along the path of coercion that Seers had foreseen if any amicable agreement were not reached, by announcing the imposition of exchange controls at a speech at Mulungushi.^{16/} In future, the companies would only be able to remit abroad a maximum of 50 per cent of their profits or 30 per cent of their equity capital. The President's justification for this step was the "virtual lack of mining development since

^{14/} MARTIN op. cit., pages 132-133

^{15/} The Economist December 12th 1964.

^{16/} KAUNDA, K. "Towards Economic Independence" Mulungushi Speech April 19, 1968, Lusaka: Zambia Information Services 1968, cited in The Economist April 27th 1968.

Independence" for, whereas the mining companies "could have embarked upon further expansion if they chose to devote part of their profits for this purpose. Instead of re-investment they [had] been distributing over 80 per cent of their profits every year as dividends". In the same speech, the President announced that certain companies would be invited to offer the Government a 51 per cent interest in their enterprises.

These Mulungushi nationalizations did not include the copper industry, but the whole drift of Government policy was in the direction of state participation in the copper industry. This was especially the case in June 1969 when President Frei of Chile announced the "agreed nationalization" of the two operating companies belonging to Anaconda.^{17/} The basis of the deal was that Chile would acquire 51 per cent of the shares and pay for them at book value over twelve years at 6 per cent interest. It also had the option to acquire the remaining 49 per cent between 1973 and 1982, at a valuation based on earnings. Even before Frei had come to power in 1964, the smaller group in Chile, Kennecott, had offered the Government a 51 per cent interest in its El Teniente property.^{18/}

7.2.3 Mr. Faber's Arguments for Nationalization

Zambia carefully watched developments in Chile and so by December 1968, when Mr. Michael Faber delivered his paper in Lusaka outlining a possible

^{17/} MARTIN op. cit. pages 158-159.

^{18/} For an account of Chileanization see MORAN, T. Multinational Corporations and the Politics of Dependence: Copper in Chile Princeton, Princeton University Press, 1974.

scheme for the Government to acquire 51 per cent ownership in the mining companies he could begin by stating that "everybody knows that sooner or later the Government will take control of the industry."^{19/}

Faber said that there was a "national need" to expand Zambia's future copper production by more than was at that time envisaged by the two major mining groups. He compared the plans for the expansion of the Zambian industry over the next five years with those of Chile, Peru, Canada and other countries. Capacity had to be increased to ensure that foreign exchange earnings would not fall if the copper price declined, as it was expected to in the early 1970s, and that employment in the mines was not cut back too sharply, thereby increasing the number of urbanized job seekers.

The reasons that he gave for why plans for future production were so modest were the companies' fears of world over-production and of a lower copper price, the uncertainty that hovered over their fate and made them require a large prospective profit before undertaking investment, the royalty and export tax arrangements, the fear that the cost increases that had occurred - and those that might be forced on them thereafter - could render future mines at anticipated copper prices unprofitable or only marginally profitable and, to a lesser extent, the difficulty of raising new capital to finance any large expansion.

In this latter connection, Faber argued that there appeared no likelihood that either of the main mining groups would be willing or able to raise fresh equity capital on acceptable terms to finance expansion; fears of nationalization had depressed share prices and increased yields, making new

^{19/} FABER M.L.O. "A Future for Zambia's Copper Industry" in FABER, M.L.O. and POTTER J.G., Towards Economic Independence, Cambridge, Cambridge University Press, 1971, pages 126-134.

equity capital very expensive or impossible to raise. On the other hand, the companies were prepared to use retained profits, to the extent to which it was not possible to distribute them outside the country, and loans from other sources to finance expansion.

Some of the factors inhibiting expansion, in particular the tax structure, could have been changed without nationalization and Mr. Faber's proposals indeed included a 40 per cent commutation of the combined export tax and royalty in exchange for the Government's acquiring 19 of its 51 per cent ownership of the properties. However, he saw nationalization as necessary because no promises from the Government not to nationalize the properties would affect the market's opinion of the companies' share, and therefore their ability to raise capital, in the face of the restrictions on the payment of dividends, the amendments, proposed in December 1968 and to be voted on in June 1969, to those constitutional clauses dealing with the acquisition of property, and a genuine feeling that important people in Government were dissatisfied with the position and the performance of the companies. Furthermore, Faber commented that while the companies might be able to find finance to develop the mines when the copper price was high, this would not be the case when the price fell.

7.2.4 The President's Reasons for Nationalization in 1969

Within a year of Mr. Faber's proposals, the President, in August 1969^{20/} announced that the Government would invite the companies to offer the

^{20/} KAUNDA K. "Towards Complete Independence" The Matero Speech August 11, 1969, Lusaka, Zambian Information Services, 1969. Extracts are given in FABER, M.L.O., and POTTER, J.G., op. cit. pages 127-134.

Government a 51 per cent shareholding in their properties and that it would pay for this share on the basis of the book value of the properties. He repeated the exact words that he had used at Mulungushi in 1968 about the companies' not expanding their properties. To further expansion, the system whereby the companies held mineral rights over large parts of the country in perpetuity without having any obligation to develop the minerals within them was abolished. Henceforth all the country's mineral rights reverted to the state and companies had to apply for exclusive prospecting and exploration licences which were valid for four and three years only and carried minimum expenditure obligations. If a mineral were found within the areas, the Government could grant a 25 year exclusive mining licence over the property, which would give the State the right to obtain 51 per cent of the mining venture formed after it had paid its share of the pre-production costs. Those areas where no prospecting activity had taken place since Independence would revert to the State, and new investors were to be encouraged to look for minerals in the areas the companies would abandon. The President's intention was, clearly, to make the companies concentrate their exploration effort and to introduce competition.

The change in the prospecting régime need not have implied the nationalization of the existing mines, and indeed did not come as much of a surprise. Nationalization was, though, a surprise. The President justified this as setting the "Nation well and truly towards its economic independence", which could not be achieved "without the Nation acquiring full control of the existing mines".

The President made it clear that he could not follow Faber's plan and pay any money immediately for its shares or remit taxes as the revenues were needed

for the country's development programme. Payment was, then, to come from future dividends. Lastly, all the companies in which the Government would have control would be run on "strictly businesslike lines".

7.3 The Cancellation of the Management Contracts

Zambia was and is still clearly very dependent on its copper industry. In 1968, the year before nationalization, the industry contributed 39 per cent of net domestic product, 60 per cent of Government revenue and 96 per cent of exports.^{21/} The future of the country was, then, dependent upon the decisions taken in the boardrooms of the mining companies and, to that extent, the country could be said to have lacked "economic independence". The 1969 reform did, then, achieve economic independence in that the Government's nominees, the "A" directors, were in a majority of six to five on the boards of directors of the reconstituted companies. However, the former owners were given management contracts that allowed them to appoint the Managing Directors of the companies, made them responsible for providing technical services, including the provision of personnel, and for selling and marketing the copper produced.^{22/} Furthermore, the "B" directors, representing the 49 per cent private interest in the companies, had a veto in so far as all expansion plans and appropriations out of profits for capital expenditure or expenditure on

^{21/} Zambian Mining Year Book 1973 Kitwe, page 20.

^{22/} Details of the contracts with Roan Selection Trust are contained in Appendices to Explanatory Statement of Roan Selection Trust Ltd. for Meetings of Shareholders to be held on 6th August 1970, 30th June 1970 and in BOSTOCK and HARVEY, C., Economic Independence and Zambian Copper, New York, Praeger, 1972, Appendix A.

exploration or prospecting had to be approved by both the "A" and "B" voters separately. Moreover, these "B" directors were specifically required not to approve any undertaking for which the companies could not raise money on "commercially attractive terms". Also, all profits not appropriated for capital, prospecting or exploration spending or needed for working capital had to be paid out as dividends. The Government could not then devote mining profits (as distinct, of course, from its tax revenues from the mines) to non-mining activities. Finally, the Government undertook not to increase the rate of taxation on mining profits or to impose exchange controls as long as the bonds it had issued for its 51 per cent share in the mining properties were not redeemed.

In return, though, the Zambian Government acquired the management services of the former owners who were to provide their services with the intention that the business affairs and operations of the new companies should "be maintained in a manner no less efficient and to an extent and standard no less than those before 1st January 1970, and which shall be directed towards the optimisation of production and profit".^{23/} The contract could be cancelled by the Government-owned companies before the end of 1979 if they gave two years' notice and if the management's performance of their duties should fall below the standard maintained during private ownership.^{24/}

These management contracts did not last until 1980 for, in August 1973, the President redeemed the balance of the bonds, which Zambia had issued and cancelled the management contracts. He criticized them for the reasons given

^{23/} Appendices to Explanatory Statement op. cit. page G-1.

^{24/} Ibid. page G-3.

above, and also for the management fees being excessive and for there being no provision for the recruitment of Zambians into the industry.^{25/} However, the companies insisted that they be compensated for their loss of earnings. They were in a strong position since, fearing some break of the nationalization agreements by the Government, they had insisted in 1970 that these stipulate that disputes be submitted to binding and conclusive arbitration by the International Centre for the Settlement of Investment Disputes of the World Bank. If Zambia had not complied with the results of such arbitration, it would have automatically been denied further Bank loans. It was only after a year of dispute and in the face of the threat from Amax of being brought before the Centre that at the end of 1974 the Government agreed to pay Anglo American \$52 million and Amax \$34 million.^{26/}

These payments were an unanticipated cost of cancelling these agreements. Leaving aside any effects on business confidence, the other cost of doing so was that the Government used part of a \$150 million loan it had

^{25/} Wall Street Journal, 4th September 1973, page 3. For a detailed criticism from the Zambian point of view, of the management contracts, vide USHEWOKUNZE C.M. "The Legal Framework of Copper Production in Zambia" and SIMWINGA G.K. "The Multinational Corporations and a Third World Host Government in a Mixed Enterprise: the quest for control in the copper mining industry of Zambia", in SEIDMAN A. (ed) Natural Resources and National Welfare: the case of Copper Praeger, New York, 1975.

^{26/} However, as the operating companies and not the Zambian Government were to pay the compensation, Amax and Anglo American were in effect contributing to their own compensation (Mining Journal September 13, 1974, page 229).

earlier raised at 13 per cent on the Eurodollar market, on the understanding that the funds were to go towards expanding capacity, to repay the balance of \$210 million at 6 per cent that it owed Amax and Anglo-American.^{27/}

It was though, henceforth able to raise taxes and impose exchange controls. Moreover, it gained further control of the industry with the establishment of a Metal Marketing Company, wholly owned by the Government, and charged with handling all the metals sales of the Zambian industry.

Once again, the Government claimed that the private owners of the mines were not expanding capacity sufficiently rapidly; because the companies were reluctant to plough their profits back into expansion, mining activity had been "almost brought to a halt", according to the Ministry of Planning's Economic Report for 1973.^{28/}

7.4 An Assessment of the Reasons for Nationalization

7.4.1 The overall objectives

This review of the events leading up to and following the 1969 nationalization shows that, while reasons of national pride were paramount, economic factors played an important role in determining Government policy. Its position was clear: the private owners were not doing enough to expand

^{27/} Cf Financial Times October 10th, 1973.

^{28/} Republic of Zambia, Ministry of Planning and Finance, Economic Report 1973, Lusaka. Presented to the National Assembly, January 1974, page 181.

production, increased production was necessary to increase Government revenues and these were needed for the country's development. As the Zambian Government is a price taker rather than maker, there was no possible conflict between a high level of production and high Government revenues; the Zambian Government could not behave like a monopolist and decrease production to boost the price of copper and therefore its own revenues.

There were secondary issues involved, Zambianization being the most important one, and these will be examined; but clearly the prime indicators of the industry's performance will be the revenue the Government obtained from the industry, and the scale of the expansion in production.

7.4.2 Internal problems with the reasons for nationalization

It must be pointed out that the reasons for the nationalization and the assumption of management control that we have discussed above do present some difficulties.

In the first place, the criticisms of the companies' performance, upon which so much of these measures' justification depended, were often vague and were particularly so in one respect: they did not document the companies' reluctance to expand capacity by detailing which were the projects they could have embarked upon but which they declined to for the variety of reasons outlined above - fear of taking risks, reluctance to reinvest profits rather than repatriate them. Faber stated that "It is known that there are substantial ore-bodies which could be mined but which in present circumstances are not likely to be so ..." and said that the national need to expand production by more than was envisaged by the companies "can be argued but

in this paper is taken as given". ^{29/}

The companies consistently denied that they were anything but vigorous in developing the industry. Sir Ronald Prain was a persistent advocate of this position. In 1964, he said that the implication in the Seers Report that the companies had not developed their concessions as vigorously as they might have done was "entirely without foundation".^{30/} He argued that if the royalty situation were corrected, then world economic conditions, the financial climate in Zambia and the prospects for the copper market would determine the amount of investment that could be generated to put extra deposits to work. He repeated this view even after the nationalization in 1969 when he stated that "our policy of expansion has been fully pursued during the years since Independence and ... no mining development has been inhibited through lack of finance, or affected by previous dividend policy, but only by the time-consuming process of technical study and appraisal of viability and, of course, by the constraints imposed by the royalty and export tax formulae".^{31/}

^{29/} FABER op. cit. pages 62, 63.

^{30/} PRAIN, SIR RONALD Selected Papers Volume IV 1964-1967 London, RST Group 1968, page 10.

^{31/} PRAIN, SIR RONALD "State Participation in the Zambian Mining Industry" August 22, 1969. Appendix to Roan Selection Trust, "Statement by the Chairman" to accompany Annual Report 1969. Page 8.

Independent observers supported Sir Ronald's claim as to the performance of his group. The Mining Journal wrote in November 1968 that the achievements of the copper industry since Independence had been "remarkable" and that the increased rate of activity had been due to "vigorous expansion programmes" undertaken by the two groups.^{32/}

By introducing this argument about the companies' lack of interest in developing their properties without adequately supporting it, the Seers Report can be said to have helped advance the action which it said it wished to forestall - namely the nationalization of the industry. Charges and counter-charges as to the companies' policies helped prevent them and the Government from sitting down and working out the type of agreement that the Mission proposed.

The Seers Report was a cautious document in that it saw the dangers inherent in nationalization, both on the performance of the industry and also on Government revenues which would become more volatile if they came from an equity interest rather than from such taxes as royalties. Moreover, the Report argued that not much could be done to change the level of employment in the industry.

Mr. Faber, on the other hand, argued the need to increase production so as to maintain employment. However, these increases in production would, as he correctly saw, be coming on the market when it would already be over-supplied. He did not address the problem of whether increasing capacity at the end of the 1960s was really justified - whether, in fact, the Zambians would find themselves within a few years with excess capacity on their hands

^{32/} Mining Journal November 22, 1968, page 393.

because of their adherence to a future agreement with other producers to cut back production in order to maintain prices. Anti-trust legislation would have prevented the private companies from entering into a formal agreement with other producers to cut production, but if the industry were nationalized, this inhibition would have been removed.

Mr. Faber had argued in favour of creating conditions that allowed future production to be "maximized".^{33/} The management agreements, though, specified that the companies should operate their properties with a view towards an "optimisation" of production and profit. This could be a semantic difference, but in chapter 2 we saw how the maximization of future production is not the correct objective for the owners of a mining property, or rather not a sufficiently clear description of it. "Optimisation", which would suggest that the reserves are exploited to yield the maximum net present value over time, is a preferable description of what the owners should aim for. Indeed it is one that the companies themselves used.^{34/}

In using this term and in specifying that the companies should continue to operate the properties as efficiently as before nationalization, the Government appeared to support the companies' view that they had followed the correct policy before nationalization. Moreover, the President said that the new companies would be run along strictly businesslike lines. If indeed strictly business considerations - for instance the fear of adding to an impending copper surplus, which Mr. Faber suggested was one of the reasons the

^{33/} FABER op. cit. page 62.

^{34/} PRAIN, SIR RONALD "Mining and the public interest" Address to the Mining and Metallurgical Society of America, New York, April 29th, 1958. Reprinted in Selected Papers, Volume II, 1958-1960 London, RST Group, 1961, page 3.

Zambian producers were hesitant about enlarging their own capacity^{35/} - were to continue to apply, then it is difficult to see how the pre- and post-nationalization performances of the industry could be expected to differ, and, therefore, why the Government was so critical of the performance of the industry under private ownership.

This apparent difficulty would have been resolved if the Government had thought that it was expropriating the companies' assets. In this case, even though the performance of the industry might not have changed, the Government would still have been making a net gain in recovering, without payment, all the rents and normal profits from the mines. However, the Zambian Government never advanced this as a reason for nationalization and always claimed that it paid the companies adequate compensation. Furthermore, one of the arguments in favour of state participation was that it would actually help the companies by removing uncertainty and, after the nationalization actually took place, it was claimed that the companies were reasonably happy about the deal they obtained.^{36/}

7.5 The way in which nationalization took place

This issue of whether the companies were satisfied by the nationalization is an important one, as it will help answer whether any real change in the industry was effected by it, and, therefore, whether the industry's performance could be expected to be different.

The possibility of State participation was certainly something that the companies had long been aware of. In his 1981 account, Sir Ronald Prain showed how the group considered that the attainment of political independence

^{35/} FABER op. cit. page 63.

^{36/} Cf BOSTOCK M. and HARVEY C., op. cit., page 178 and POTTER J.G. "The 51 per cent Nationalization of the Zambian Copper Mines" in FABER and POTTER op. cit., pages 118, 125.

by Zambia would involve some degree of State ownership of the mines.^{37/} Both Roan Selection Trust and the Zambian Anglo American group had accepted the Seers recommendations that the Government acquire a stake in the industry.^{38/} Roan Selection Trust at that time had thought of the State acquiring a 20 per cent interest immediately and increasing this over a period of time to 40 per cent, but with other countries, and particularly Chile under President Frei, taking over majority ownership of their mines, it became clear that the Zambian Government would eventually do the same. Sir Ronald Prain felt that it would be better if this were accomplished by negotiation and in an amicable atmosphere and that a long delay would allow political pressures to build up that might result in a much worse deal for the private shareholders. Accordingly, about 18 months before the August 1969 takeover, he approached the Zambian Government privately and offered to negotiate 51 per cent Government ownership with it. American Metal Climax had to be convinced of the wisdom of this offer, but finally accepted Sir Ronald's arguments. The Anglo-American group did not go along with this proposal.

As nationalization was not arrived at as a result of a private negotiation, it is impossible for us to compare what happened in 1969 with what might have happened in 1967 or 1968. However, it is clear that the arrangement finally arrived at was not the kind of one that Roan Selection Trust, at least, would have welcomed as removing uncertainty.

Evidence for this came from the testimony under oath of the senior directors of the Trust in a court case in the United States in 1970 over the terms under which Amax proposed to buy out the public shareholders of Roan

^{37/} PRAIN *op. cit.* (1981) pages 172, 223.

^{38/} PRAIN *op. cit.* (1968), page 11. The rest of this paragraph is based upon interviews with senior executives of Roan Selection Trust.

Selection Trust.^{39/} They argued, and the judge, Thomas Masterson, allowed their testimony to stand, that they did not believe the consideration to be paid by the Government was fair compensation, that they would never have chosen book value, which the Government offered to pay, as a basis for

^{39/} SKLAR R.L. Corporate Power in an African State: the Political Impact of Multinational Mining Companies in Zambia. Berkeley, University of California Press. 1975.

Pages 49-50 contain an account of the end of Roan Selection Trust as an independent company that is more readily accessible - and shorter - than the court documents referred to. After the acquisition of 51 per cent of Roan Selection Trust's mining properties by the Zambian Government, its other assets could have been transferred out of the country as Zambian Anglo American's assets had been transferred to a new company, Zambia Copper Investments, incorporated in Bermuda in November 1969. The board of Roan Selection Trust, meeting without Amax representatives, favoured regenerating the Trust as an international mining house domiciled in Luxembourg or the United States but eventually found this idea impractical. This, according to Philadelphia District Court Judge, Thomas Masterson, put Amax in a position of strength when it set about acquiring the 57.7 per cent interest in Roan Selection Trust it did not own. He concluded that Sir Ronald Prain was "bargaining from a position of weakness in a situation which was inherently coercive to him and the public shareholders of Roan Selection Trust" while the Amax directors "were able to drive a hard bargain to wash out the public shareholders as cheaply as possible while securing for Amax unique high-yielding assets." (Kohn v. American Metal Climax Inc. and Roan Selection Trust Ltd. (D.C. Civil No. 70-933), Joint Appendix, pages 2,218 ff; and Wall Street Journal, November 27, 1970, page 4). Masterson said Amax was interested in acquiring Roan so that it could use its cash for financing its own foreign investments, but he decided that it had violated the Securities Exchange Act of 1934 in that an explanatory statement sent to Roan shareholders contained "materially misleading information" and omitted other vital data.

It should be noted that the dispute was between Amax and dissident Roan shareholders and not between Amax and the Zambian Government. In fact, when, after a shareholders' meeting in Lusaka, 85.5 per cent of all Roan shareholders other than Amax approved the acquisition of Roan by Amax (Wall Street Journal, August 7, 1970, page 14) and the High Court of Zambia upheld the terms of the amalgamation as being just and equitable to all shareholders, the Federal Appeals Court had to conclude that the underlying fairness of Amax's acquisition could no longer be questioned (ibid, April 3, 1972, page 6). In the opinion of the present writer, Sir Ronald Prain and the other non-Amax board members of Roan Selection Trust obtained an extremely good deal from Amax for the non-Amax Roan shareholders - a deal that, at no time after 1970, would ever have been offered by Amax.

compensation and that the consent of the Trust's management and Board to the agreement was not in any real sense voluntary.^{40/} The management contracts, which were thought by some observers to be very generous,^{41/} were thought by many members of the Board of Amax to be insufficiently remunerative.^{42/}

It can, then, be concluded that the nationalization of 1969 and the subsequent cancellation of the management contracts produced a very different result from that which would have been arrived at by completely free negotiations. In that case, the Government would have had a large and probably even majority, shareholding in the existing companies, the management would have been more independent of the State, although this is not to say that it would not have included many Zambian citizens. As was clear to those involved in advising the Zambian companies in 1969, the management contracts did not give the companies the same control over operations as they had enjoyed before. Without a majority on the board, the companies no longer had the last word.^{43/} As Ian MacGregor, then Chairman of Amax, stated "we were facing a new and completely untried situation. Our management were now going to be under the control of a foreign government. When things pass into the

^{40/} Kohn v. American Metal Climax Inc. and Roan Selection Trust Ltd., op. cit., Testimony of Robert Page and Sir Ronald Prain and Findings of Fact, Opinion, Conclusions of Law and Order of Judge Masterson, November 25, 1970. Joint Appendix pages 340a-341a, 1280a and 2177a.

^{41/} Cf Financial Times October 10, 1973.

^{42/} Interview with a senior director of Amax.

^{43/} Testimony of Morris Wright in Harold E. Kohn v. Amax. op. cit. page 507a.

hands of government operation, they are not necessarily as efficient as they were before".^{44/}

It can be seen, then, that to those involved at the time the change in 1969 was a very important one.

7.6 Reasons that were not given for Nationalization

Transnational corporations have frequently been the object of much criticism for unethical business practices or for meddling in the affairs of the host country.

In the case of the nationalization of the Zambian copper mines, such issues did not arise. The two major companies, Zambian Anglo-American and Roan Selection Trust, were registered in Zambia, as were all their mining company subsidiaries. Their books were audited by Deloitte, Pender, Griffiths, Annan and Co. which, as Deloitte, Hawkins and Sells, continues to audit the books of the nationalized mining industry.

The Zambian companies did make payments for services incurred abroad, but this was inevitable in the case of large mining companies serving consumers world-wide. There has, as far as the present writer is aware, not been any criticism of the companies for using excessive head office expenses or payments to subsidiaries to transfer profits out of the country. Furthermore, the possibility of using transfer prices to distort the true picture of their operations was very limited in the case of the Zambian copper mining industry.

^{44/} Testimony of Ian MacGregor ibid page 327a.

which produced refined copper, whose price is publicly quoted, and whose inputs of capital equipment and stores could in most cases be accurately costed.

As regards the companies' political activities, by the time of nationalization, Zambia had been independent for five years and almost fifteen years had passed since the first major steps had been taken on the way to African advancement in the industry.

Moreover, the Zambian Government, as the Government of the country in which the companies were registered and in which they had their assets, had all the means at its disposal to force them to obey the laws of the land and to avoid illegal political activities. The possibilities of conflicts of interest existed. For instance, if Roan Selection Trust, in which the American Metal Climax and American shareholders held the majority of shares, had registered with the Securities and Exchange Commission of the United States, as Amax had wanted it to, this would have meant that the company would have had to refer to the political and economic problems of Zambia in its reports. At the time of the Rhodesia Unilateral Declaration of Independence in 1965 when there was a threat of a cut-off of transport lines and power supplies, the Trust's directors thought it would have been very difficult to have given a full report of the situation that did not embarrass the Government of Zambia. This was one of the reasons they refused to register the company.^{45/} Similarly, the Trust refused Amax's instructions not to

^{45/} Testimony of Sir Ronald Prain in ibid page 1267a.

sell cobalt to communist countries, arguing that only the Government of Zambia could issue such instructions.^{46/} The present writer has not seen evidence of similar possible conflicts of interest being resolved at the expense of Zambia.

The foregoing does not imply that the Zambian Government was happy about the way that the companies conducted their business - simply that it did not accuse them of acting improperly or illegally. As we saw, it thought that the companies were expatriating too much of their profits and that they were not expanding production sufficiently rapidly, and later, that their management fees were excessive. However, these and other aspects of the companies' operations did not involve any question of illegality.

They really revolve around the economic question of comparing the consequences of having an industry run by private foreign capital - such as adherence to commercial principles as the companies understand them, the need to pay out dividends to attract capital, and to pay at or even above the market rate for management services - with the consequences, including those to efficiency and profitability, of having it run under Government ownership. In the next chapters, we will be analyzing whether in the Zambian case the change from private to Government control did affect the efficiency of operations and, more generally, whether it allowed the Government to attain the development goals it set itself.

^{46/} Ibid page 1290a.

7.7 Summary

There is little doubt that the main reason for the nationalization of the zambian copper industry was one of economic nationalism - the feeling that Zambia should exercise her permanent sovereignty over her natural resources. However, economic reasons were given for the desirability of nationalization. It was argued that the companies were not increasing production and opening up new mines sufficiently rapidly, that under them employment would probably decline and that their investment performance was poor.

The nationalization of 1969 gave the zambian Government majority ownership but not management control of the industry and these arrangements were criticized. In particular, it was argued that the minority shareholders had a veto on expansion plans, and on the use of unappropriated profits, that the management fees were excessive and that there had been no provision for the recruitment of zambians into the industry. The cancellation of these contracts allowed the Government to assume complete control of the industry and to be totally responsible for its development.

Chapter 8

THE PERFORMANCE OF THE INDUSTRY AFTER NATIONALIZATION

From the preceding analysis, it can be seen that nationalization was expected to bring about an improvement, or at least no deterioration, in the performance of the industry as assessed by the variables examined in Chapter 6. We will go through its performance under each heading, as in that chapter, trying to give explanations for any difference in performance except for those specifically dealt with in the following Chapter, 9, namely the changes in the copper market and the effects of the struggle with the minority régime in Southern Rhodesia and the attempt to develop new routes for Zambia's trade that did not pass through its minority-ruled southern neighbours.

8.1 Production after nationalization

Table 5.2 and Graph 6.1 showed that one of the prime objectives of nationalization, namely an increase in the production of copper, was never attained and even at the present time shows little sign of being attained — copper production did not increase. By 1983, production, at 515.2 thousand tonnes was below the total of 719.5 thousand tonnes reached in 1969 or of 576.4 thousand tonnes reached in 1960. As Graph 6.1 showed, the fall in Zambian production has been fairly steady since 1976. Moreover, Zambia's shares in world, the market economies' and the developing countries' production have all fallen steadily. It was not the case, then, that Zambian production has fallen because it joined other producers in limiting production to stabilize the market, as happened in the early 1960's.

8.1.1 The effects of the Mufulira disaster on production

In the early years of nationalization, the disaster that struck the Mufulira mine in September 1970 can explain some of fall in production. In this disaster, 89 men were killed by a cave-in and inrush of mud into the underground workings which reduced the mine's capacity drastically.

production, in terms of recoverable copper, which had been 165,507 tonnes in 1969/1970, the financial year before the disaster, was only 71,769 tonnes in 1970/1971.^{1/} By the end of 1976, the rehabilitation of the mine was completed and the mine's production was about 130,000 tonnes a year.^{2/} In 1977, production rose to 142,000 tonnes of recoverable copper.^{3/}

At the time of the disaster there had been plans to increase the capacity of the Mufulira mine from 165,000 tonnes per year to 190,000 tonnes^{4/}, and to expand the mine's smelter capacity from 178,000 tonnes a year to 230,000 tonnes to take care, not just of the mine's own expansion, but also of increased production from other mines in the Roan Selection Trust group.^{5/} The expansions in smelter capacity could only come in large blocks - as whole new furnaces would have to be added. In Mufulira's case, the expansion in smelter capacity could only have been up to 230,000 tonnes, for by then there would have been very little room left in the central plant for additional equipment^{6/}. To this extent 230,000 tonnes was the natural maximum capacity of the mine's plant. As a result of the accident, though, the Mufulira mine's rate of production was permanently reduced to a maximum of 160,000 tonnes of

1/ Roan Consolidated Mines Annual Report 1971, page 22.

2/ Zambia Mining Yearbook 1976, page 8.

3/ Roan Consolidated Mines, "Statement by the Chairman" to accompany Annual Report 1980, page 3.

4/ Roan Selection Trust "Statement by the Chairman, Sir Ronald L. Prain, OBE" to accompany Annual Report 1968.

5/ RST Group of Companies "Statement by the Chairman, Sir Ronald L. Prain, OBE," to accompany Annual Report 1969.

6/ Interview with Sir Ronald Prain, August 1983.

copper. Instead of the cheaper block-caving methods that were being used at the time of the disaster, more expensive sandfill methods had to be resorted to as a result of the disaster.^{7/}

The effects of the Mufulira disaster were, then, to limit the feasible production from the mine to the levels of production reached before the disaster. In the early years after the disaster, too, the energies of Roan Consolidated Mines were diverted from possible expansion programmes elsewhere to the rehabilitation of the mine. By 1976, though, rehabilitation was largely over and so after this year the company's production could have been expected to have been at roughly the level of 1969/70 and to have risen subsequently. However, as Table 5.3 showed, the company's production never reached the levels of 1969/70 and indeed fell after 1974/1975.

The effect of the Mufulira disaster on costs can best be appreciated from Table 5.12. Mining costs per tonne rose from K 2.98 in 1970 to K 4.77 in 1971. However, these costs fell after 1971 and by 1973 were lower than those at Luanshya, just as they had been before the disaster. Even though they rose subsequently they still remained below Luanshya's costs. It should be borne in mind that the later figures for Luanshya included Baluba and so they did not simply reflect the increasing costs as the old Roan Antelope mine approached exhaustion. In sum, given that Mufulira accounted for about 20 per cent of Zambian copper production in the late 1970s, and that its mining costs were below those at Luanshya, it would be difficult to maintain that the disaster and the need to resort to sand-fill methods of mining could be responsible for all the increase in costs that might have occurred in Zambia.

^{7/} Roan Consolidated Mines Annual Report 1978, page 34.

Although the Mufulira disaster can be held partly responsible for the fall in the Roan Consolidated Mines' output, at least in the early years, it should have had no effect on Nchanga Consolidated Copper Mines' output. The Nchanga Company's production did indeed rise to a maximum in 1972/73 of 440 thousand tonnes. After that year, though, it declined, on the whole steadily, to reach 356.5 thousand tonnes in 1980/81. There was, then, not a marked difference in the performance of the two companies, at least after the mid-1970s: production of both fell away.

8.1.2 The effects of the switch towards cobalt on production

Another factor that may have influenced the fall in copper production was the Zambians' decision to boost cobalt production. The primary reason for an increase in production of cobalt was that cobalt ores were found in the mines being developed or at existing mines. One of the largest cobalt producers was Baluba which had been discovered before the war but whose development was delayed until the other properties, including Chibuluma and Chambishi, had been opened up. Its capital costs in relation to expected output were not as favourable as for other properties,^{8/} and cobalt prices were not high enough to justify development. Eventually, Baluba was opened up after 1969 to replace rather than to add to declining production at Luanshya. Production started in 1973. Baluba's ores contain about 0.14 per cent cobalt and the cobalt from this mine, together with that from Chibuluma, is treated at the Chambishi roast leach electrowinning plant.

In the Zambian Anglo American group, Nkana had long been a cobalt producer. However, in 1979, cobalt ores were also found in the Nchanga Lower Orebody underground and production commenced in early 1980.

^{8/} vide CUNNINGHAM, S. J., The Copper Industry in Zambia, New York, Praeger, 1981, pages 104-106.

At this time, producers were optimistic about cobalt. In May 1978, the Shaba province of Zaire was invaded by irregulars from Angola and it was feared that the country's cobalt output would take a long time to recover and that supplies on the world market would be further tightened. A situation of tight supplies was expected to last until at least 1983.^{9/}

Investment in cobalt facilities must be seen against this background. Also, rather than go directly into projects to expand copper production from new or existing mines, investment in the 1970's increasingly tended to go towards projects designed to cut costs, to obtain copper from previously-mined material, and to boost the output of cobalt. Thus, at the same time, in 1979, that Nchanga Consolidated Copper Mines Ltd. was pursuing a policy of restricting capital expenditure,^{10/} it was planning to invest in expanding the production of cobalt^{11/} whose producer price in February of that year stood at \$25 per lb., as opposed to \$6.85 in the previous May.^{12/} By 1980, Nchanga Consolidated Copper Mines had arranged for finance, amounting to K108 million, for its cobalt projects,^{13/} of which the most important was a roast leach-electrowin cobalt plant at Rokana. Similarly, in 1976 construction started on expanding the leach plant at Chambishi to increase the company's copper output and its cobalt production from 500 tonnes a year to 2,400 by

9/ Mining Annual Review, 1979, page 81.

10/ Nchanga Consolidated Copper Mines Ltd. Annual Report 1979, page 17.

11/ Ibid., page 6-7.

12/ Ibid, page 15.

13/ Nchanga Consolidated Copper Mines Ltd. Annual Report 1980, page 17.

1978. This occurred at a time when Roan Consolidated Mines was striving to otherwise reduce its capital expenditures.^{14/}

The cobalt projects did lead to a rise in Zambian production of cobalt, from 2,052 tonnes in 1970 to 3,309 tonnes in 1980, and to an increase in the gross revenue from this metal from K4.52 million to K141.7 million between those two years. In the same period, the value of copper production rose from K648.0 million to K955.4, so it can be seen that the increase in the value of cobalt production equalled 45 per cent of the increase in the value of copper production.^{15/}

Any such comparison is, of course, dependent upon the sales prices of copper and cobalt. In 1978/79 when Roan Consolidated Mines was hoping to produce 2,400 tonnes of cobalt which would provide a net benefit to the gross profit on sales of K70 million, it thought that "for a number of years demand for cobalt will exceed supply and consequently high prices will prevail."^{16/} However, the assumptions on which these forecasts were based were soon belied by events. In particular, production in Zaire was hardly affected by the 1978 invasion. By 1982, the free market price of cobalt had reached an all time low in real levels of \$3.50 per pound and, Zambia deliberately curtailed its production.^{17/} In the financial year, 1982/83, Zambia Consolidated Copper Mines' cobalt sales amounted to only K49.8 million as against electrolytic copper sales of K867.8 million.^{18/}

^{14/} Roan Consolidated Mines Annual Report 1976, page 2.

^{15/} All figures from Republic of Zambia, Monthly Digest of Statistics, Central Statistical Office, Lusaka.

^{16/} Roan Consolidated Mines "Statement by the Chairman" Annual Report 1978, page 6.

^{17/} Zambia Consolidated Copper Mines Ltd. 1983 Annual Report; pages 13 and 6.

^{18/} Ibid, page 12.

From the preceding account, it can be seen that Zambia seriously started expanding cobalt production in the late 1970's, when its copper production was already slipping. Cobalt production was expected to add extra revenue, rather than to actually replace copper production. Investment in copper operations was being cut back, but the intention was still to maintain production. The fall in copper production cannot then be explained by the increase in cobalt production. In any case, after 1980, cobalt production fell and was only 2,407 tonnes in 1983.

8.2 Productivity and efficiency

8.2.1 The relationship between productivity and production

As Table 5.3, and graphs 6.3 and 6.4 showed, productivity both in terms of copper and ore output per employee and per local employee fell off sharply after 1969. The graphs showed that productivity tended to follow the trend in production - this was particularly noticeable in the case of productivity in terms of ore production. In the pre-nationalization period, though, production was on a generally rising trend and so falls in production that took place in 1961, 1962 and 1966 were reflected by falls in productivity as the mines did not adjust their labour forces for such temporary shortfalls. However, since 1972 copper production, and, since 1974, ore output have been falling fairly steadily and the mines have not adjusted their labour forces to take account of this trend. Indeed, as Graph 6.10 makes clear, whereas the private companies had reduced their labour forces somewhat in years of falling production, 1961 and 1962, and after 1967, it was only in 1977 that the Zambian mines' labour force began to decline. Moreover, as Graph 6.4 indicates, the productivity problem can be said to have become serious in 1972 for although it was the peak productivity year of the post-nationalization years, it was not the year of peak ore production: productivity began to decline even before ore output did.

8.2.2 Productivity and the decline in grades

The Zambian mines have been getting deeper and ore grades have been falling, which would make it more difficult to maintain production and productivity. In the period before nationalization, the grade of ore milled fell from 2.98 per cent in 1960 to 2.70 per cent in 1969, although it was only after 1965 that the decline was clearly evident. Grades continued to decline after nationalization, from 2.67 per cent in 1970 to 2.25 per cent in 1981, with the fall becoming most pronounced after 1975. The fall in grades after nationalization was, then, greater than the fall before. This will affect productivity expressed in terms of finished copper per employee rather than productivity expressed in terms of ore output per employee, which is, of course, not directly affected by the grade of ore extracted.

8.2.3 Productivity and mining methods

There is no single explanation for why the decline in grades before 1970 was accompanied by a rise in productivity in terms of ore output and why the decline after 1970 was accompanied by a decline. Some of the mines, particularly Luanshya, were becoming more difficult to work, but new mining methods were being introduced to help compensate. In particular, the companies made progress towards mechanization in the years after Independence. For example, after November 1964 Mufulira introduced a new method of mining - cascade mining - into one section of its lower ore body as part of its mechanization programme. This method was expected not only to increase labour productivity but also to reduce to a minimum the pillars, that themselves contained ore, that were left between sections of the ore body after extraction in order to prevent caving: total ore recovery as a result increased from 70 to 84 per cent.^{19/}

^{19/} World Mining (U.S. Edition), June 1966, page 14-15.

Just as mechanization tended to contain the increase in costs so, other things being equal, did the initial trend towards open pit operations. Open pits usually have the advantage over underground mines of enabling the material to be brought to the surface at considerably lower capital and current cost, since the costs of constructing underground workings, of ventilation, dust extraction and the prevention of caving are avoided. Their disadvantage is that overburden as well as ore has to be brought to the surface and when the open pit becomes deep and the stripping ratios (i.e., the ratio of overburden to ore extracted) rise the cost of mining a ton of ore from an open pit can exceed the cost of extraction from underground workings.

Table 8.1 shows that the percentage of ore production from open pits had risen from 10.8 per cent and zero in 1960 for the Zambian Anglo American and Roan Selection Trust groups respectively to 35.5 per cent and 11.6 per cent in 1969. After 1969 the percentage of ore coming from open pit mines increased in the case of Nchanga Consolidated Copper Mines Ltd. to reach a maximum of 51.7 in 1979/80. The increase was proportionately smaller than that of the 1960s.

Only one mine, Chambishi, in the Roan Consolidated group was operated as an open pit, but after 1978/1979 the open pit was closed and all ore came from the underground sections. The maximum that the ore production from the group's open pits reached as a percentage of total ore production was only 14.6 per cent, in 1971/72.

Unfortunately figures on productivity, or production costs which can be used as a proxy, from open pit as opposed to underground workings are not readily available for Zambia. No production costs were given for the mines of Nchanga Consolidated Copper Mines, which produced the greatest amount of ore from their open pits, particularly from Chingola. Also, no division was

Table 8.1 Zambian ore production by method of extraction
(million tonnes and percentages)

Year	Zamanglo/ NCCM <u>a/</u>		Roan Selection Trust/ Roan Consolidated <u>b/</u>	
	Total ore production (mn tonnes)	Percentage from open pits	Total ore production (mn tonnes)	Percentage from open pits
1960	10.318	10.8	11.005	0.0
1969	15.337	35.5	16.537	11.6
1970	-- <u>c/</u>	--	16.148	9.6
1971	21.193 <u>d/</u>	41.9	12.849	13.8
1972	17.989	42.9	14.189	14.6
1973	18.371	43.9	15.794	14.1
1974	18.235	42.4	16.983	11.7
1975	19.028	44.9	15.982	9.2
1976	17.786	45.8	15.831	10.6
1977	17.330	46.0	15.325	8.3
1978	16.532	48.4	14.798	8.8
1979	17.153	50.7	15.497	8.4
1980	16.880	51.7	11.079	0.0
1981	16.523	51.5	13.579	0.0
1982	15.939	n.a.	14.116	0.0
1983	15.911	42.5	15.171	0.0
1984	15.413	43.9	13.082	0.0

Source: Roan Selection Trust, Roan Consolidated Mines, Bancroft Copper Mines Ltd., Nchanga Consolidated Copper Mines Ltd., Rhokana Corporation, Zambia Consolidated Copper Mines Ltd., Annual Reports.

a/ Years ending March 31st, except for Bancroft 1960 and Rhokana 1960 and 1969 when years ending June 30th. Bwana Mkubwa and Kansanshi mines are included. After 1981, figures are for the Chingola, Konkola and Rokana divisions of ZCCM.

b/ Years ending June 30th. After 1981, figures for for the Luanshya, Mufulira and Kalulushi divisions of ZCCM.

c/ Omitted because of incompatible financial years.

d/ For fifteen months ending March 31st 1971.

operated entirely by open pit methods and so it is not possible to judge costs by simply comparing, for example, the manpower/production ratios of different divisions.

Mining costs were, though, given for Roan Consolidated Mines' properties until 1976/77 and those for Chambishi are given in Table 8.2. The costs of extracting a tonne of ore from the Chambishi open pit were multiplied by the ratio of total material extracted to ore extracted (1+stripping ratio) to arrive at the figure for the cost of mining one tonne of ore. The tonnage of material removed from the open pit is also given, as well as the costs of mining a tonne of ore by underground methods.

It can be seen by comparing the figures for the costs of producing a tonne of ore from the Chambishi open pit with the figures given in Table 5.12 for the mining costs per tonne of ore from the other underground mines in the Roan Consolidated Mines Group that open pit mining was not necessarily a cheaper mining method than underground mining. The large underground mines, Luanshya and Mufulira, frequently had mining costs lower than did Chambishi's open pit. Moreover from Table 8.2 it can be seen that costs rose quite sharply after 1973 as the tonnage extracted from the open pit mine declined until, by 1977, costs were higher than at the underground sections.

While no definite conclusions can be made just on the basis of this review of one mine, it would appear that the trend towards open pit operations did generally add to productivity in the 1960s as new mines were being opened up by the Zamanglo group, but that in the 1970s the impact was smaller. In the first place, the trend towards open pit operations slowed down, and, in the second place, the open pits themselves were becoming more mature, deeper properties where difficulties in ore extraction began to mount, leading to increasing costs.

Table 8.2 Chambishi Mine: Open pit and underground costs 1970-1977
(Kwacha per tonne)

	Mining costs per tonne of material	Open Pit Mining Costs per tonne of ore	Stripping Ratio	Open pit production of material (mn tonnes)	Underground mining costs per tonne of ore
1970	0.53	3.58	5.76	9.08	..
1971	0.55	4.22	6.68	12.75	..
1972	0.52	3.62	5.96	12.74	..
1973	0.46	3.25	6.07	13.58	..
1974	0.59	4.07	5.90	12.42	..
1975	0.73	6.59	8.02	11.10	9.10
1976	1.15	6.88	4.98	8.67	9.78
1977	1.54	12.08	6.85	6.67	11.38

Source: Roan Consolidated Mines Annual Reports.

Even so, open pit operations were still more efficient than underground mines if we are to judge by production costs. The figures for Chambishi showed that only in 1977, the year before the open pit closed, were production costs there higher than in the underground workings. Moreover, in 1978, of the Nchanga Consolidated Copper Mines divisions only Chingola, the division with the largest open pit production, was profitable.^{20/} Finally, as in the 1970's the trend towards open pit operations was slowed down rather than reversed, it is difficult to see how this could have led to a reversal in the productivity trend, from an increasing to a decreasing trend.

8.2.4 Efficiency in the treatment plant

The increasing amounts of ore removed from the Chingola open pit and the change in the ores extracted from that mine towards oxide ores meant that recoveries at the Nchanga Treatment plant went down, as shown in Table 5.8. The fall in the recovery rate does not, then, represent a fall in efficiency but rather the attempt to extract as much copper as possible from the material being brought to the surface. That there was no collapse in the efficiency of the Zambian treatment plants can be seen from the figures for the other mines, especially the underground mines, which treated predominantly sulphide ores. The total changes in the recovery rates between 1969 and 1983 were normally of the order of one percentage point. There were fluctuations from year to year of more than this, but these were often due to changes in the ores being treated. The TORCO plant was of much less importance than the other treatment plant as it treated about 100,000 tonnes of ore a year rather than the 4 million or more tonnes of ore treated by the concentrator for Nkana's underground ore. As it was a new process, the relatively poor results at that plant are no reflection on the overall high levels of recovery at the other treatment plants.

^{20/} Nchanga Consolidated Copper Mines Ltd. Annual Report, 1978, page 3.

8.2.5 The accident rates

The safety record of the Zambian mines after nationalization was, on the whole, good. The first year, 1970, was marred by the Mufulira disaster which led to a drastic increase in the fatalities. However, it was purely coincidental that the accident took place after nationalization as its genesis can be traced back to 1933 when concentrator tailings started to be poured into the depressions on the hangingwall side of the orebody.^{21/} Events were to prove that putting tailings over the orebody was an unsafe practice, for it was through a sinkhole that developed beneath the surface accumulation of tailing that a million tonnes of tailing, rock and soil poured into the mine. With hindsight, it can be said that, as the Zambian miners were hard rock miners, they should have sought advice from outside about soft materials behaviour. There were some worries about the tailings. Even before the disaster, doubts had been raised about the practice for after the Aberfan accident in Wales, in October 1966, Sir Ronald Prain wrote to Mufulira mine's management to obtain an assurance that there would be no slippage of the tailings.^{22/} It would, then, be unfair to attribute the Mufulira disaster to any slackness in safety precautions that followed nationalization.

From 1969 until 1979, the accident rates went down quite considerably as shown in Graph 6.5. However, in 1980, all three accident rates increased quite markedly. This was attributed "to the prevailing difficulties in obtaining qualified and experienced staff as well as equipment and spares."^{23/} We argued in the previous chapter that the stabilization of the

^{21/} Roan Consolidated Mines, "Statement by the Chairman, Mr. Dominic C. Mulaisho, to accompany Annual Report 1971, page 1.

^{22/} Information from a conversation with Sir Ronald Prain in August 1983.

^{23/} Zambia Mining Yearbook 1980, Kitwe, Zambia, 1981.

labour force caused by Zambianization helped the safety record. Now, apparently the wheel had gone full circle and problems were coming from the lack of experience of the other component of the labour force, expatriates. Also the economic difficulties the industry was suffering from were finally taking their toll on safety.

8.3 The costs of production

8.3.1 Nominal costs f.o.r. mine

The nationalization of the industry was accompanied by the abolition of two taxes that were levied on production rather than profits -- mineral royalties and export taxes, the latter having been introduced in 1966. This has been taken into account in Table 5.10. The first column showed costs free on rail (f.o.r.) at the mine; and its break-down, which was not given in the years before nationalization, was shown in Table 5.11. The cost of sales was given in the last column of Table 5.10. Both these figures were from the company reports. The difference between them was the sub-total made up of transport to an African port, handling and freight charges and administration and selling charges.

It can be seen from these figures that in absolute and percentage terms the greatest increase in costs came from costs f.o.r. mine. Between 1970 and 1981, these increased by K1040 per tonne or by 306 per cent. Other costs increased by K193 per tonne or by 156 per cent. As a result total costs of sales increased by K1233 or by 266 per cent. This last increase is much greater than that which occurred between 1960 and 1969, of 39 per cent.

In the 1960's, the costs f.o.r. mine and cost of sales had sometimes fallen from one year to the other, and had only definitely established themselves at a much higher level than at the beginning of the decade in 1967.

However, after nationalization, costs rose steadily. There was a sharp increase in 1971. This was partly due to the Mufulira disaster, but also to the change in accounting procedures described in 5.5.1. The figures for 1971 were not, then, strictly comparable to those for 1970.

Only between 1977 and 1978 did the increase in costs appear to have been slowed down. In November 1977, a commission of enquiry was appointed by the President of Zambia to look into the copper industry and recommend how production costs might be reduced.^{24/} At that time, the country was encountering grave difficulties and was on the point of applying for a Standby Agreement from the International Monetary Fund (see above 4.2.3). As a result of the economy drive, capital and operating expenditures were cut down at all divisions of Roan Consolidated Mines. Some employees were redeployed, others took early retirement, overtime payments were reduced, materials usage was lowered and the use of contractors restricted.^{25/} The Kalengwa mine was closed as well as the Geological Research and Prospecting Departments of Roan Consolidated Mines' Geological Services at Kalulushi.^{26/}

Over the long run such a drastic cut back could not be maintained. Indeed, Table 5.11 showed that costs excluding depreciation rose between 1976/77 and 1977/78 from K765 per tonne to K777 per tonne and it was only because of the reduction in depreciation expenditure that costs f.o.r. mine fell by K3 between those two years. After 1978, costs rose again to reach K1380 f.o.r. mine in 1980/81. Part of the reason for this was the 10 per cent

^{24/} Mining Annual Review 1978, page 481 and Nchanga Consolidated Copper Mines Ltd. Annual Report 1978, page 3.

^{25/} Roan Consolidated Mines Annual Report 1978, page 4.

^{26/} Zambia Mining Year Book 1977, page 17.

devaluation of the Kwacha that was part of the International Monetary Fund's package, and part also was the increase in the cost of petroleum fuel.

8.3.2 Deflated costs of production 1970-1981

There was a very rapid increase in global inflation in the 1970s and this was taken account of in Table 6.1 and Graph 6.7. The deflated figures show that Kwacha costs in Zambia did not rise consistently more quickly than the unit values of the exports of manufactured goods from the developed market economies, which we have used as a deflator to express the rise in world prices. Instead the trend was very erratic. The deflated figures do, though, show that costs were contained quite well after 1977, but that they began to get out of control again in 1980. Because of their great variation, a trend rate of growth has little meaning but for the period 1970-1981, costs f.o.r. rose by 1.6 per cent per annum, when the dollar index is used, and by 1.9 per cent per annum when the Special Drawings Rights Index was used. (This rate of growth being calculated as the slope of a regression line through the figures). In the period 1961-1969 the trend rate of growth was higher at 2.8 per cent. When the trend in the cost of sales less royalties and export taxes is calculated, similar results were obtained. In the period 1960-1969, this rate of growth was again 2.8 per cent, and, in the period 1970-1981, it was 2.1 per cent if the dollar index was used, and 2.6 per cent if the SDR index was used.

Another indication that costs were kept under control comparatively well in Zambia is that they are still not drastically out of line with those of other producers. In 1983, it was estimated that the weighted average production cost of copper in the market economies (with this cost being defined as total operating costs, net of by-/co-product credits and including

depreciation, interest and other charges) was 72 cents/lb. Zambian costs were 81 cents per pound, but were lower than those of some other major producers, such as the United States (84.5 cents/lb); Australia and Canada (84 cents/lb) and Zaire (83 cents/lb). They were, though, higher than new producers such as Papua New Guinea (35 cents/lb), South Africa (66 cents/lb), Mexico (68 cents/lb) and Peru (69 cents/lb). The only long established producer with lower costs than Zambia was Chile at 49 cents/lb.^{27/}

We have not made comparisons in this study with the performance of other copper producing nations, because of the difficulties in accounting for exchange rate movements and, also, because of differences in geological structures, but these figures do not indicate any drastic deterioration in Zambia's cost position in relation to other producers' since nationalization. Even before nationalization, it was calculated that Zambian costs, were "about level with the world average".^{28/} Since 1960, it had been recognized that Zambia was not a low cost producer in terms of the world average.^{29/} It should be pointed out though, that at that time, Zambian costs of production included royalties so they were higher than they would have appeared after 1969.

27/ Figures from Mining Journal August 17, 1984 page 106, based on studies by Brook Hunt and Associates Ltd. of London (ibid August 24th 1984 page 122).

28/ PRAIN, Sir Ronald "The Copper Industry" (Address to Zambia Association for National Affairs", Lusaka, December 11th 1964, reprinted in Selected Papers Volume IV (1964-1967) RST Group London 1968, page 5.

29/ PRAIN, Sir Ronald "The World Copper Industry": Address to the Rhodesian Economic Society, Salisbury, October 11th 1960 reprinted in Selected Papers Volume II (1958-1960) Rhodesian Selection Trust Group, London, 1961 pages 147-148.

8.3.3 Efficiency in the use of fuel

Reference was made earlier to the effect of the increasing cost of petroleum on mining costs. We now deal with the energy question. Fuel is a very large input into treatment processes, particularly mining, concentrating and smelting, rather than refining which operates on electricity that in Zambia is provided from hydro-electricity, the cheapest form of energy. Table 5.12 showed that there was a sharp rise in all these costs of treatment between 1973 and 1975, reflecting the increase in fuel prices in international markets.

Unfortunately, such a cost break-down is not available for years after 1976/77. However, we have given in Tables 8.3 and 8.4 some of the relevant statistics for Zambia's fuel picture which should facilitate our discussion of the mining industry's use of fuel. In earlier years, before the oil price rise of 1973-1974, such detailed figures were not given. It can be seen from Table 8.3 that hydro-electric power provided over half of the country's energy needs, and that coal and coke, most of it from local sources, provided about 15 per cent, although this declined as oil's contribution, all imported, increased slightly, from 26.1 per cent in 1974 to 27.4 per cent in 1981.

The Zambian mining industry's share of the total consumption of energy in the country declined over time and the industry increased its consumption of the cheapest fuel, electricity. It can be seen from Table 8.4 that electrical energy's cost actually declined during the 1970's whilst the cost of oil imports increased rapidly. In particular, between 1978 and 1981 the value of oil imports f.o.b. went up by 172 per cent, whilst their volume actually fell by 4 per cent.

We have seen no figures for the annual consumption of oil by the mining industry but steps were taken to substitute electricity for this fuel. For

Table 8.3 The Zambian Mining Industry's Consumption of Energy in the National Context - 1974-1981

	Percentage of <u>Zambian Energy From:</u>				<u>Percentage consumed by Mining Industry</u>
	<u>Hydro</u>	<u>Coal and Coke</u>	<u>Oil</u>	<u>Other</u>	
1974	55.5	18.2	26.1	0.2	61.6
1975	54.8	18.0	27.0	0.2	61.4
1976	56.4	16.7	26.6	0.3	61.3
1977	57.7	16.5	25.4	0.4	62.1
1978	58.2	14.6	25.8	2.0	59.4
1979	58.2	13.9	26.8	1.5	45.9
1980	58.1	14.5	26.4	1.5	53.8
1981	57.7	12.7	27.4	2.4	48.5

Source: Bank of Zambia Annual Report various years.

Table 8.4 Zambia's Oil and Energy Needs: Selected figures 1970-1981

	<u>Zambia's Imports of Oil (tonnes)</u>	<u>Cost of Oil Imports f.o.b. Kmm</u>	<u>Electricity Supplied to Mining Industry (GWh)</u>	<u>(From Copperbelt generators (GWh))</u>	<u>Wholesale Price Index for electricity (1970=100)</u>	<u>Mining Industry's consumption of coal (tonnes)</u>
1970	..	..	3 324	334	100.0	673 078
1971	..	..	3 567	285	95.5	654 999
1972	478 500 ^{a/}	11.5	3 828	236	97.8	n.a.
1973	852 137 ^{b/}	16.6	4 058	223	92.9	n.a.
1974	808 950	46.0	4 416	251	89.4	436 105
1975	852 073	49.2	4 466	290	87.8	460 270
1976	907 615	63.5	4 588	149	90.8	334 614
1977	776 929	67.4	4 504	139	87.3	327 554
1978	780 154	68.1	4 490	111	83.3	316 997
1979	699 328	97.1	4 554	58	82.7	218 238
1980	761 882	154.0	4 685	77	80.9	228 072
1981	750 543	185.0	..	..	81.6	..

Source: Bank of Zambia Annual Report, various years, Zambia Mining Year Book, various years.

^{a/} Refined expressed in crude oil equivalents.

^{b/} Includes imports of crude oil as well as exports of refined products. Figures are expressed in crude oil equivalents.

instance, at the Nchanga Open Pit 120-tonne trucks now use an electrically operated trolley assist which not only increases their speed, but also saves 40 litres of fuel per trip.^{30/} Most of the electricity consumed by the mines comes from hydro-electricity, although there are some thermal stations on the Copperbelt operated on coal. Coal is also used for metallurgical purposes. The figures show that the electricity provided from the Copperbelt's generators declined over time from 334 GWR in 1970 to 77 GWR in 1980, and that coal consumption fell from 673,000 tonnes to 228,000 tonnes.

Part of the reason for the decline in the consumption of fuel by the Zambian mining industry does lie with the fall in production. Even so, the figures all show that the industry's fuel consumption and the fuel balance adjusted to changing fuel prices in the 1970s: the overall consumption of fuel fell and that of the cheapest available fuel, electricity, rose.

8.3.4 The cost of labour

In Chapter 6.4.2, we argued that the award of the Brown Commission in 1966 had added substantially to costs but had preserved industrial peace in the industry. Table 5.13 showed that the cost of labour as a percentage of cost of sales reached a maximum in 1966 and 1967, of 37 per cent. By 1980, it had declined to 22 per cent. The reason for this was not a rise in the contribution of the other identified item - transport costs - to the cost of sales for these in fact fell, but rather a rise in other costs - from 48 per cent of cost of sales in 1967 to 70 per cent in 1980.

The Brown award brought real wages, in terms of wages deflated by the appropriate consumer price indices, to the highest level they were to attain in the period under examination (table 5.15 and graph 6.9). Although, nominal

^{30/} Zambia Consolidated Copper Mines Ltd. Annual Report 1983, page 16.

wage rates did increase in 1970, in 1973 and in subsequent years, inflation still kept real wages below their levels of 1966. Moreover, after 1973, no wage award allowed the workers to recover their real wage levels of 1970. Real wages in the first year of nationalization were, then, on the whole at the highest level they were to reach. By 1981 they were substantially below their levels of that year for all the categories of local workers we have examined.

There was apparently some movement towards reducing wage differentials between the higher and lower paid workers. Comparing the mid-points in the nominal wage rates of 1981 with those of 1970, the P1 workers nominal wages increased by 108 per cent, those of the P5 worker by 107 per cent, but those of the P11 workers by 65.6 per cent. Even so, the latter's wages were 270 per cent higher than those of a P1 in 1981, whilst in 1970 they had been 366 per cent higher.

The reduction in real wages after 1973 can be viewed as a positive achievement by the industry as the fall in copper prices made it necessary to contain costs, including those of labour.

8.3.5 The progress of Zambianization

In chapter 6.4.3, we looked at the process of Zambianization in terms of the replacement of expatriates by Zambians. After nationalization, the process continued, with the annual expansion in the Zambian labour force reaching a maximum of 3449 people in 1974 when the expatriate labour force fell by 113 people (see Table 6.2). As we saw in Chapter 7.3, when cancelling the 1970 management contracts in 1973, the President had complained that these contracts contained no provision for Zambianization. The 1974 figures can then be taken as a vindication of his criticisms, although the displacement ratio for that year, as for 1973, was very high. Moreover, there was no escaping retrenchment when the economic crisis arrived and the Zambian labour

force was cut back sharply in 1978 and 1979 and in 1982 and 1983. Over the whole decade 1970-1980, the size of the Zambian labour force increased in absolute terms by 75 per cent more than it had in the previous period, 1960-1969. On the other hand, although there were sharp cutbacks in the expatriate labour force, particularly after 1975, the average displacement ratio was higher than it had been in the 1960s. This was, to the same extent, to have been expected because the more expatriates were replaced, the more those remaining would tend to be in the higher level posts whose replacement would be more difficult. It was only in 1982/83 that a Zambian, E.K. Shamutete, became an acting manager of a mining division (Konkola).

In the early days, Zambianization had affected non-technical areas such as Administration and Personnel, with Personnel being rapidly Zambianized. However, in 1983 there were 22 Zambians at assistant underground managerial level and above, 23 Zambian geologists and 46 mining graduates at various stages of development. In metallurgy, there were 17 Zambians at plant metallurgist level and above, and 66 other Zambian metallurgical graduates. There were 38 chemists, 41 Zambians at section engineer level and above, and 107 other Zambian graduate engineers.^{31/}

The achievements of the Zambianization programme can not be ignored, but the fact remains that this programme was begun under the private companies before nationalization and would have been pursued by them. Moreover, the manpower problems within the industry were often caused by a shortage of skilled expatriate workers, and, it was sometimes suggested, by a decline in the quality^{32/} of those employed. In mid-1979, the mines were relying on

^{31/} Figures from Zambia Consolidated Copper Mines Ltd. Annual Report 1983, pages 14-15.

^{32/} New African, May 1978, page 246.

the services of less than 100 senior engineers, about one sixth of the number required, and the total expatriate skilled work force was about two thirds of formal establishment^{33/} and its turnover rate very high - 32 per cent as opposed to 23 per cent, still a dangerously high level, in 1968, the year before nationalization. By 1980, the turnover rate had been reduced to 25 per cent.

With the deteriorating security situation in Zambia, largely caused by the Rhodesian war, which ended in 1979 and the worsening living conditions caused by the country's economic problems, it would in all events have been difficult to have retained the services of top-level expatriate staff. However, questions can be raised as to whether the Zambian Government's nationalization of the industry and cancellation of the management contracts improved or worsened matters. The first action was bound to affect adversely the "esprit de corps" amongst the expatriate staff that came from working for companies of the international standing of Roan Selection Trust and Zambian Anglo American and to lower expatriate morale. The second action would appear to have further diminished the Government's ability to attract top quality personnel. These personnel normally prefer employment with large international mining houses which can provide them with varied opportunities to advance in their careers and, of course, with greater security of tenure than can a nationalized industry in a developing country^{34/} that, understandably, would like to see its own nationals occupy the most important positions.

33/ Mining Annual Review, 1979, page 482 and Mindeco Mining Year Book of Zambia, 1970, Kitwe, 1971, page 44.

34/ Cf. Testimony of Sir Ronald Prain in United States Court of Appeals for the Third Circuit Harold E. Kohn v. American Metal Climax Inc. and Roan Selection Trust Ltd. (D.C. Civil No. 70-933) Joint Appendix 1404a.

The two large international mining houses which were in the best position - and had the greatest incentive - to supply such personnel to Zambia were the Anglo American Corporation and Amax Inc. Even before nationalization, they had tried to ensure that Zambia was supplied with such people in spite of the great difficulties involved. The former had persuaded some of its top-level staff to go to Zambia by assuring them that a few years' service there would help advance their careers elsewhere in the group.^{35/} Indeed, the present chairman of the Anglo American Corporation, Mr. Gavin Relly, was deputy chairman of Zambian Anglo American from July 1965. Roan Selection Trust was not part of any similar group system, but the problems of attracting and retaining skilled personnel to run the mines had made Amax's chairman, Mr. Ian MacGregor, consider in 1965 or 1966 coming to some form of pooling arrangements with the Trust so as to assure its executives that "Amax was in their future".^{36/}

After nationalization, the Anglo American group could continue supplying executives as before. For Roan Selection Trust, though, matters were very different as the management, and also Amax, realized that continuing as an independent Zambian company "owning [henceforth] 37 per cent in the operating company just [made] an entirely different problem in recruiting and holding top ... and intermediate executive people".^{37/} The eventual solution to this and to other problems was the acquisition by Amax of Roan Selection Trust.

^{35/} Testimony of Mr. Ian MacGregor ibid. page 287a.

^{36/} Ibid. page 288a.

^{37/} Testimony of Mr. Morris H. Wright, ibid. page 451a, and of Mr. Ian MacGregor, ibid. page 303a.

The figure of 37 per cent (actually 36.75 per cent) is given because the 49 per cent private interest in Roan Consolidated Mines would have been split between Roan Selection Trust and the Anglo American Corporation 3:1.

Although this necessitated for it an unwelcome increase in its investment in Zambia^{38/}, it was felt to be the best way to retain the services of Roan's expatriate management without which Amax's investment in Zambia would have been worth considerably less.^{39/}

In view of all the above considerations, it would be difficult to say that the Zambianization programme would not have been pursued vigorously if the mines had remained under private ownership and control. The companies had, in any case, every incentive to pursue Zambianization as, where skills are anywhere near equal, the Zambian worker is much cheaper than the expatriate because of the latter's employment overheads. Moreover, the Government's overall objectives were to operate the mines efficiently, which required a ready availability of the most skilled workers. It would be difficult to argue that the nationalization and the cancellation of the management contracts helped achieve that particular objective.

^{38/} With a 42 per cent interest in Roan Selection Trust, Amax would have received 15.5 per cent ($.42 \times .367$) of Roan Consolidated Mines on a pro rata distribution of shares. The Zambian Government had, however, stipulated that the obligatory share in Roan Consolidated Mines of the party owning the management contract should be 20 per cent (it had originally stipulated 24 per cent but the Roan negotiators had bargained it down to the lower figure) so Amax had to increase its interest in Roan Consolidated Mines by 4.5 per cent. Its final interest in Roan Consolidated Mines was 20.4 per cent. The large share-holder interests in Amax, the Hochschilds and Selection Trust, were opposed to almost any form of acquisition by Amax of Roan Selection Trust, and Mr. Harold Hochschild would not have objected to Roan Selection Trust's buying out Amax. (Testimony of Mr. Harold Hochschild, Chairman of Amax, 1947-1957, ibid. page 1779a.)

^{39/} Indeed, after the cancellation of the management contracts between Amax and Roan Consolidated Mines, the former wrote down its 20.4 per cent investment in the latter from \$34.9 million to \$4.3 million. (Economist Intelligence Unit Quarterly Economic Review: Zambia, No. II, 1978, page 10). In 1984, Amax sold all its interests in Zambian copper to ITM International (Mining Journal, July 6, 1984, page 15).

8.3.6 Stability in management

Another consideration concerning high level management is that of its stability. Whether the senior managers are at any one time expatriates or Zambians is a separate issue from how long they have been in their posts.

The evidence is that the management of the state-owned companies was unstable in the early years of nationalization.

In Table 8.5, we give the Chairmen, Zambian managing directors and the Zambian-appointed directors and alternate directors of the two companies. For the most part, the same people served on the Boards of each of the companies. It can be seen that, until J. Mapoma took over, there was little continuity in the Chairmanship. This was not the case for Roan Selection Trust, where Sir Ronald Prain was Chief Executive from 1943 to 1968 and Chairman from 1950 to after nationalization; or for the Zamanglo Group, where Harry Oppenheimer was Chairman from 1957. These two had served on the boards before becoming Chairman whereas it can be seen that only Dominic Mulaisho had been a director before becoming Chairman. Moreover, he was the only Chairman to serve on the boards of the companies after his relinquishing the Chairmanship.

The position of managing director, once it was in Zambian hands, was stable after 1975. David Phiri, Managing Director of Roan Consolidated Mines had, though, made his previous career with the Zamanglo and Nchanga Consolidated Copper Mines Group, of which he had been an alternate director. F. H. Kaunda, the managing director of Nchanga Consolidated Copper Mines, took over and has remained in the Chairmanship of Zambia Consolidated Copper Mines Ltd., providing very necessary stability.

Table 8.5 The Zambian directors of RCM/NCCM^{a/}

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
<u>Chairmen</u>												
A. Sardanis	C	X										
D. Mulaisho	X	C	C	X				X	X	X	X	X
H. Mulemba				C								
E. Kashita					C							
A. Soko						C	C					
G. Chinkuli								C				
J. Mapoma									C	C	C	C
<u>Managing Directors</u>												
RCM D. Phiri					X	X	X	X	X	X	X	X
NCCM F. H. Kaunda						X	X	X	X	X	X	X
NCCM W. Chakulya					X							
<u>Directors</u>												
P. H. Brownrigg	X	X	X	X	X	X	X	X	X	X	X	
E. G. Kasonde	X	X	X	X								
I. Muchangwe	X	X	X	X								
F. Sumbwe	X	X	X	X	X	X	X	X	X	X	X	
L. Lishomwa					X	X	X					
L. Mwananshiku					X	X						
E. Walusiku						X	X	X				
L. Sichilongo						N	N	N	X	X	X	
F. Kazunga												X
L. Muuka		A	A	A	A	A	A	A	A	A	A	X
J. Masaninga												X ^{b/}
D. Phiri	N	N	N	N								
P. Chiwenda						A						
D. Kaona								N				
K. Nyirenda									N	N		
A. Chitulangoma							A					

Source: Company reports.

Key: C = Chairman
X = Director of both companies
A = Alternate director of both companies
N = Alternate director of NCCM only

Note: a/ Because of the different financial years and the fact that directors or chairmen did not necessarily serve calendar years, these entries can only be approximate.

b/ NCCM only.

The first Zambian Chairman (A.S. Sardanis being a Cypriot) was Dominic Mulaisho and he was widely respected in the copper industry and was thought to be favourable to private enterprise - indeed in 1972 he had said that it would be "pointless and even suicidal for Zambia to expropriate or nationalize the present operations while the country needed more companies to go to Zambia to develop mining and associated industries."^{40/} His dismissal as Chairman in September 1973 and as a director in February 1974 ushered in four years of instability both in the Chairmanship and the Directorate. Indeed Table 8.5 shows that only two full directors kept their posts from 1974, the year when Zambia assumed management control of the companies, to 1978, when drastic economy measures were imposed.

Mr. Mulaisho's successor as Chairman, Mr. H. Mulemba, only lasted until February 1974. He was replaced by Mr. Andrew Kashita who was acknowledged as having a good grasp of the copper industry. Mr. Kashita was, however, dismissed in January 1975 from the Government and the Chairmanship of the companies in favour of Mr. Ackson Soko who was described by the Mining Journal as a "UNIP stalwart with a proven political record but no background or experience in mining".^{41/} In turn, he was dismissed in April 1977, accused

^{40/} Speech to the New York Section of the American Institute of Mining Engineers reported in Mining Journal September 29, 1972, page 248.

^{41/} ibid. January 31st 1975, page 82.

of engaging in the activities of the banned opposition United Progressive Party.^{42/} The new Chairman, General Kingsley Chinkuli, had formerly been head of the Zambian Army. He only remained until June 1978 but it was under his Chairmanship that the necessity for rationalisation and cost-cutting was fully realized, and economy measures mentioned above put in place: the retirement of miners was accelerated and over 4,700 workers employed by sub-contractors for the two large copper companies were made redundant and their duties were absorbed by the existing work force.^{43/} Moreover, at the same time as General Chinkuli was appointed, Dominic Mulaisho returned to the Board, replacing Mr. Lishomwa who had taken his seat on the Boards in February 1974. Mr. Mulaisho's return, coming at a time when commercial considerations and the reality of the market were forcing the companies to adopt policies which the private owners would almost certainly have instituted, was an indication that the objectives and outlook of the companies had finally returned to ones very similar to those held and pursued by the former private owners.

^{42/} ibid. April 29th 1977, page 323.

^{43/} ibid. April 21st 1978, page 297.

8.4 The performance of investment

Because of the criticism directed against the private companies for not investing enough in their properties, we will examine carefully the performance of investment after nationalization.

8.4.1 The rise in the capital stocks

Graph 6.11 and 6.12, drawn from Tables 5.16 and 5.17 showed that the capital stocks of both groups, measured in nominal terms, did increase after nationalization. The net assets of Nchanga Consolidated Copper Mines Ltd., in particular, showed a sharp increase after nationalization.

In chapter 6 we discussed the difficulties in estimating the net fixed assets of the companies in real terms and in Table 6.3 gave estimates using different deflators. Only one deflator, the GDP deflator, unadjusted for changes in the terms of trade, showed an increase for the two groups between 1970 and 1981. The GDP deflator adjusted for changes in the terms of trade gave a slight increase for Roan Consolidated Mines between those years and an 18 per cent drop for Nchanga Consolidated Copper Mines Ltd. The use of the wholesale price index of goods for fixed capital formation, which had given favourable results for the pre-nationalization period, led to falls of 41 and 53 per cent for Roan Consolidated Mines and Nchanga Consolidated Copper Mines respectively.

What all the indices did indicate, though, was that at some time in the mid 1970s - between 1973 and 1975 when the wholesale price index or the adjusted GDP deflator was used, and in 1976 or 1978 when the simple GDP deflator was used, - the real net capital stock of the companies reached a maximum.

We also gave, in Table 6.4, a measure of the real capital stock which reflected the definitions used in the company reports but which was so calculated that it did not show any decline over time. Even so, this

measure showed that the real assets of the two companies did grow rapidly between 1970 and 1977 or 1978 after which, partly no doubt because of the change in accounting procedures, the rate of increase slowed down considerably.

This brings out that two important determinants of the calculated value of real fixed assets are (1) the deflator used, which can vary, and (2) the treatment of replacements or depreciation expenditure. The company accounts only give one figure for the amount of gross capital expenditure that went on replacements rather than on building up new assets and any recalculation by us would be entirely arbitrary. However, the figures themselves show that the treatment of replacements was of critical importance to a calculation of the net capital stock.

8.4.2 The ratio of replacements to total expenditure

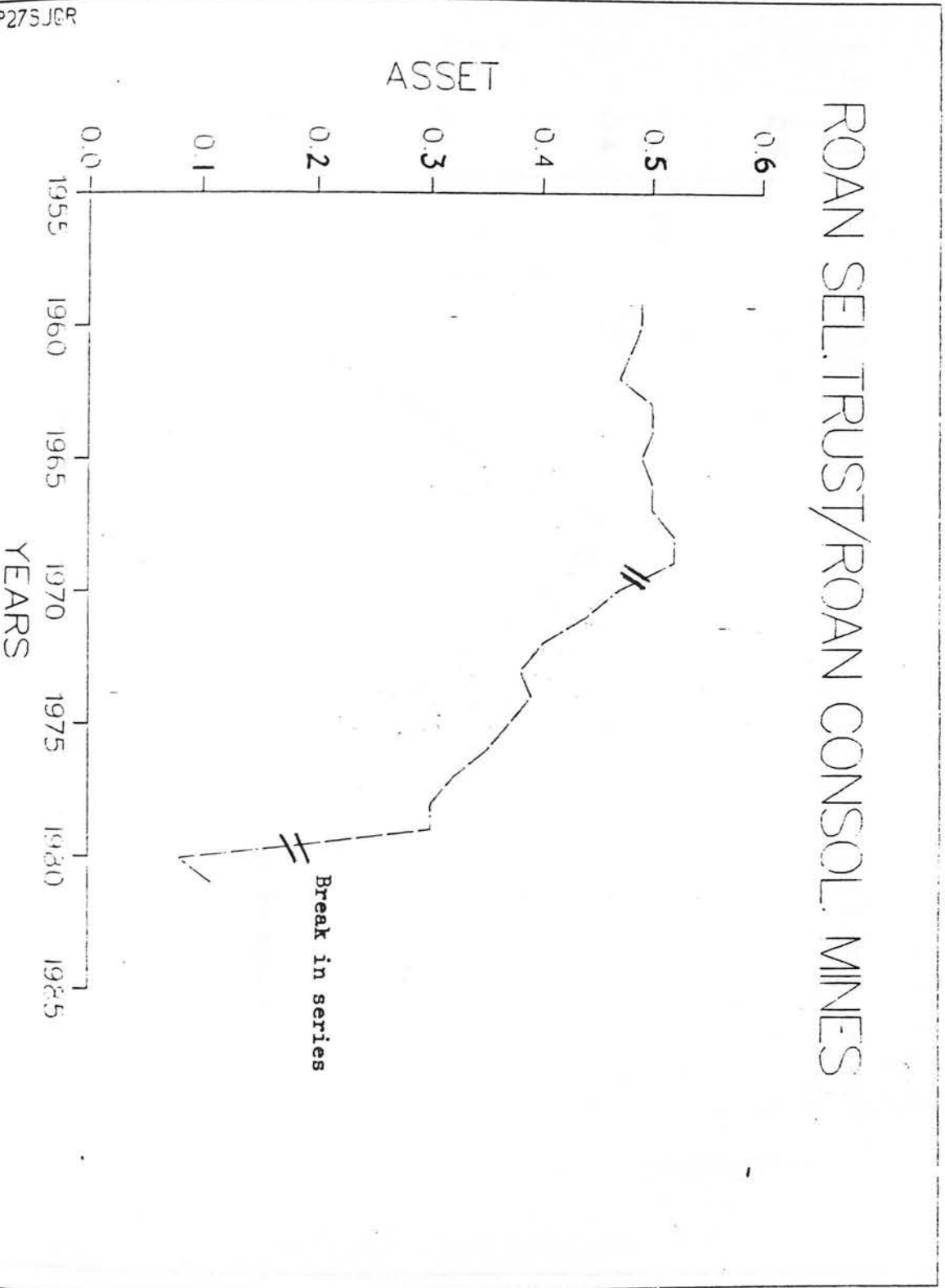
In 1970, there was a change in the treatment of replacements, as described in 5.5.1. Part of this expenditure was charged to operating costs and this amount was usually not given. Thus total and replacements expenditure, as shown in the fixed assets figures, would have appeared smaller after 1970 than before, although net expenditure would have remained the same. Also the ratio of replacements to total expenditure would have declined, as can be seen in Graphs 8.1 and 8.2.

8.4.3 Investment expenditure in nominal terms after nationalization

Leaving aside the difficulties in making comparisons between total capital expenditure before and after nationalization, it can be seen from graphs 6.13 and 6.14 that there was a sharp increase in gross and net expenditure between 1970 and 1973 in the case of Roan Consolidated

Graph 8.1 RST/RCM: Ratio of accumulated replacements expenditure to accumulated gross capital expenditure, 1959-81

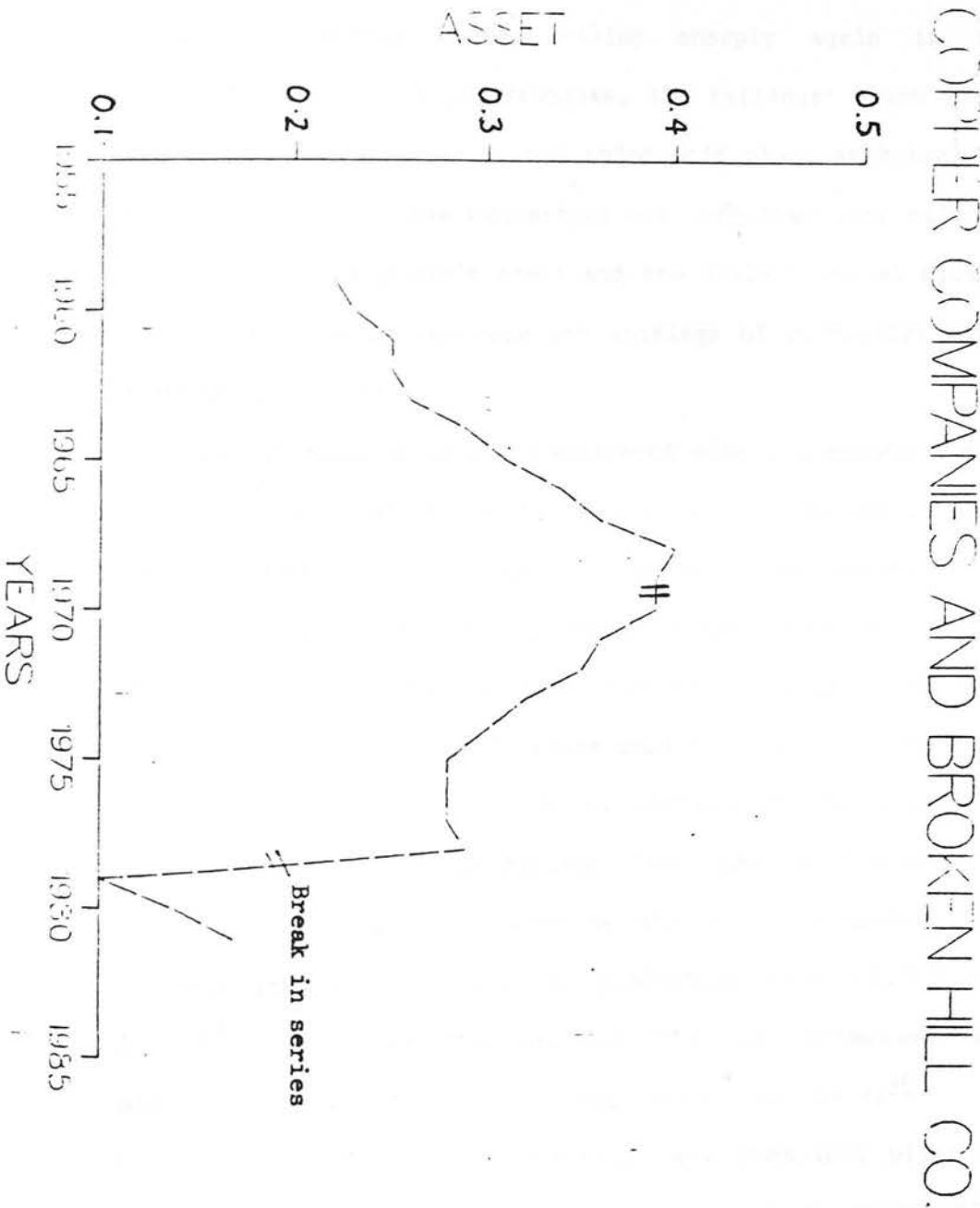
(From Table 5.16)



DPP27SJGR

NOTE: RST/RCM: Ratio of accumulated replacements expenditure to accumulated gross capital expenditure, 1959-81

Graph 8.2 Zamanglo/NCCM: Ratio of accumulated replacements expenditure to accumulated gross capital expenditure, 1959-81
(From Table 5.17)



NOTE: --- REPMIT/EXPEND

Mines and between 1970 and 1974 in that of Nchanga Consolidated Copper Mines Ltd.

For the Nchanga company, 1974 was the year in which nominal capital expenditure peaked before rising sharply again in 1980. After 1974, expenditure on its major projects, the tailings' leach plant at Chingola (see 5.2.2), the gas collection and third acid plant at Rokana (designed to collect sulphur gases from the converters and turn them into sulphuric acid to be used for leaching the group's ores) and the Waelz Kilns at Broken Hill (designed to treat the dumps of residues and arisings of refractory material at that mine) started to tail off.

In the case of Roan Consolidated mines, investment expenditure peaked in 1972 and also, at a higher nominal level, in 1977. This was because the company undertook four major projects - the expansion of the underground workings at Chambishi; the Luanshya/Baluba expansion (Stage II); the expansion of production at the western end of Chibuluma; and an extension of the Chambishi leach plant to increase cobalt as well as copper production.

In 1971, plans were made to increase Chambishi's output to about 48,000 tonnes a year and production from the underground workings began in 1972.^{44/} By June 1973, work on the Baluba extension project had started. It was intended to increase production from 22,000 to 50,000 tonnes a year.^{45/} The sinking of the new shaft at Chibuluma, which was the major part of that mine's expansion, began in 1974.^{46/} In 1975/76, Roan Consolidated Mines decided to begin the Chambishi plant extension which, as previously mentioned, it hoped to commission in early 1978.^{47/} In 1977, the final capital costs of the projects were estimated at K63 million for the

^{44/} Zambia Mining Year Book 1975, page 7.

^{45/} Roan Consolidated Mines Annual Report 1973, page 5.

^{46/} Roan Consolidated Mines Annual Report 1976, page 10.

^{47/} Roan Consolidated Mines Annual Report 1976, page 10.,

Chambishi mine expansion of which K49 million had been spent by June 1977; at K76 million for Baluba, of which K25 million had already been spent; at K30 million for the Chibuluma expansion of which K13 million had been spent; and at K26 million for the Chambishi plant extension.^{48/} However, in that year, 1977, as part of the economy drive, capital expenditures were held back as far as possible although it was felt that expenditures on these development projects were essential if current levels of output were to be maintained into the future.^{49/} Thus in the next financial year, a total of K43 million was still spent on development projects.^{50/} Nchanga Consolidated Copper Mines' was also taking steps in 1978 to cut back its capital expenditure programmes.^{51/}

This policy of cutting back wherever possible on expenditures has continued as the crisis in the copper industry has deepened. By 1983, the Chairman of Zambia Consolidated Copper Mines Ltd. explained that "the Company now has a considerable backlog of expenditure which must be undertaken in order, firstly, to replace the plant and equipment, which has already reached the end of its economic working life (our italics) and, secondly, to finance new projects Capital expenditure during the year under review (which was K252 million) was again substantially below requirements."^{52/} In 1984, the Chairman was able to report that the programme to rehabilitate the mines would cost about \$300 million, and would be largely financed by the World Bank, the European Economic Community and the African Development Bank.^{53/}

^{48/} Roan Consolidated Mines Annual Report 1977, page 9.

^{49/} ibid., page 8.

^{50/} Roan Consolidated Mines Annual Report 1978, page 11.

^{51/} Nchanga Consolidated Copper Mines Ltd. Annual Report 1978, page 10.

^{52/} Zambia Consolidated Copper Mines Ltd. 1983 Annual Report, page 5.

^{53/} Zambia Consolidated Copper Mines Ltd. 1984 Annual Report, page 4.

8.4.4 Real replacements expenditure after nationalization

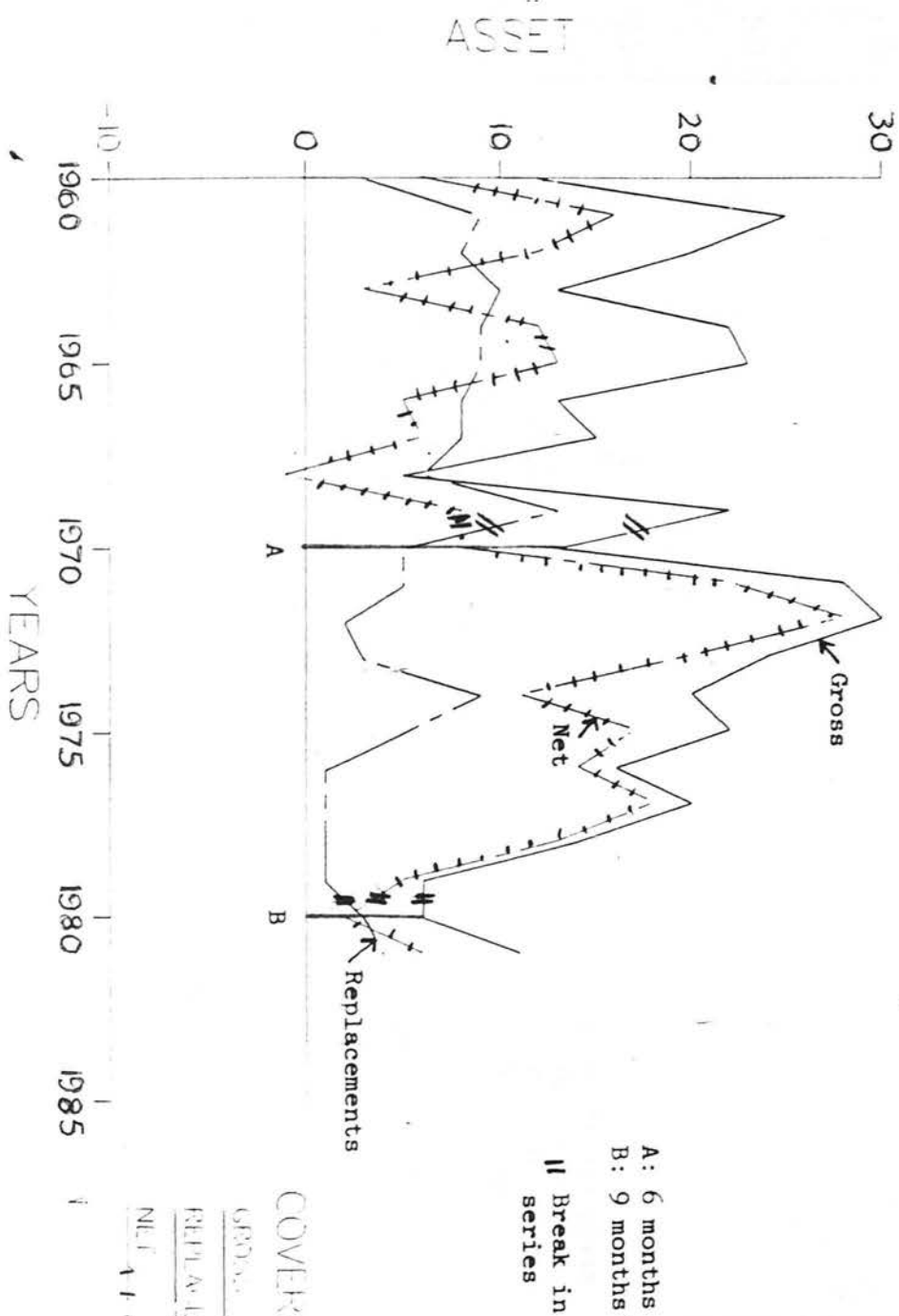
That the mines needed to be rehabilitated can also be appreciated from the data available on replacements expenditure. In graphs 8.3 and 8.4 deflated capital expenditure is given. It can be seen that real replacements expenditure after 1975 did fall off and was at a much lower level by the time the change was made to a depreciation basis of accounting than in 1970 or during the time of private ownership. As the company accounts indicate that net investment was positive and so the size of the assets was increasing, we would have expected real replacements expenditure also to be increasing, as happened in the period of private ownership. When the amounts charged to operating costs given by Roan Consolidated Mines are deflated and added to the deflated amounts written off, as in Table 5.20, the totals declined from K 7.34 million in 1976 to K 3.69 million in 1979, a level considerably below the real replacements expenditure of Roan Selection Trust. After the groups had changed to a depreciation basis of accounting, real replacements expenditure was still generally at a lower level than during the time of private ownership, as can be seen from graphs 8.3 and 8.4.

8.4.5 The overall picture of investment after nationalization

The overall picture at the end of the 1980s, then, was that of an industry whose capital stock was not in such good a shape as it was at the time of nationalization. The production achieved by these assets was at a much lower rate and part of the explanation was too low a level of investment. As the

Graph 8.3 RST/RCM: Investment expenditure in constant prices of 1971, (K million)
From Table 5.20

ROAN SELECT TRUST/ROAN CONSOLIDATED MINES

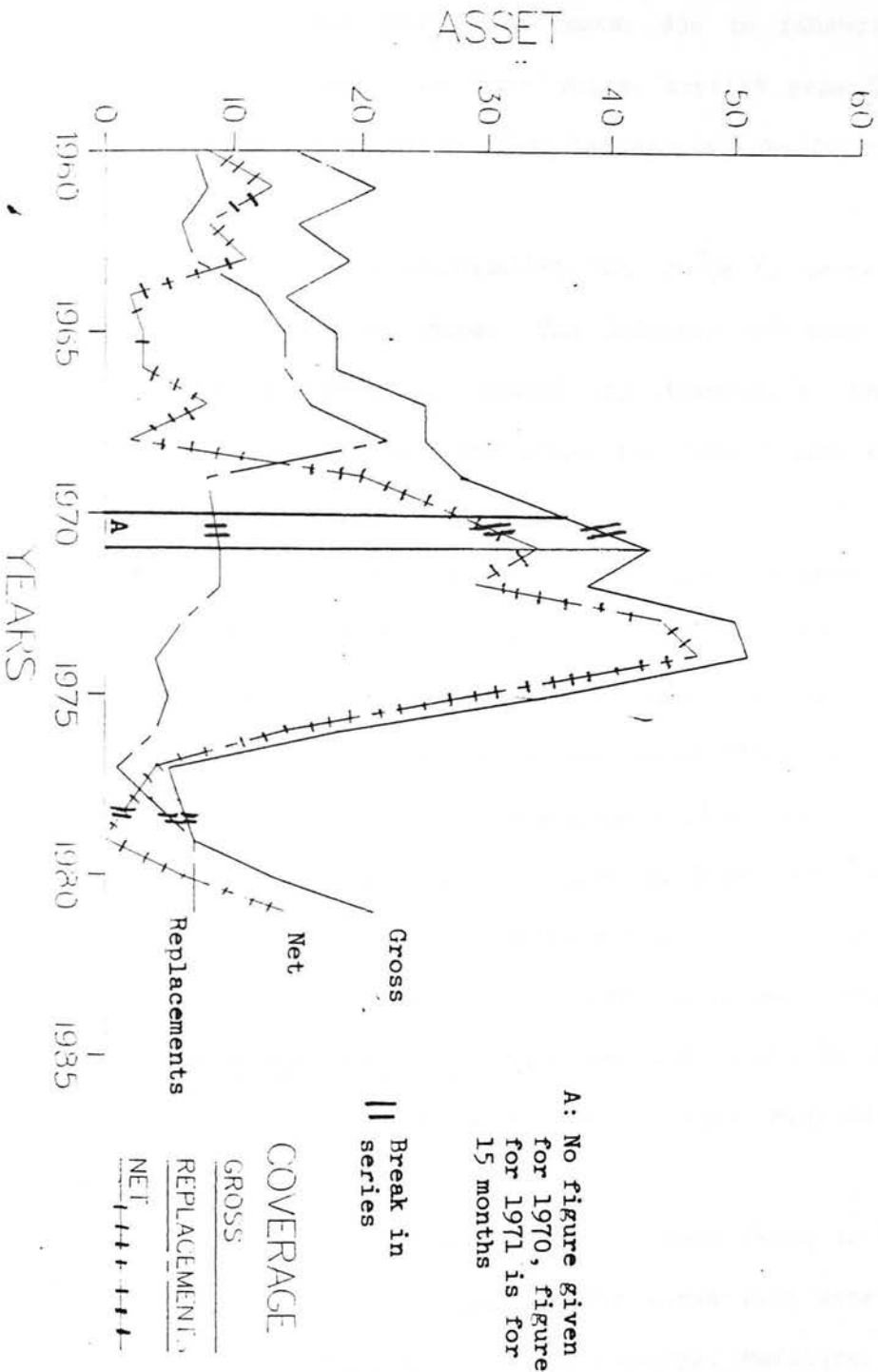


Graph 8.4

Zamanglo/NCCM: Investment expenditure
in constant prices of 1971, 1960-1981
(K million)

From Table 5.21

ZAM. ANGLO-AMER./NCHANGA CONSOLIDATED MINES



Chairman of Nchanga Consolidated Copper Mines explained in 1981. " In assessing this (minimum level necessary for capital expenditure) the low investment of the past five years, due to financial stringencies, must be taken into account. In those years, capital expenditure on improvements and replacements was deferred, thus endangering the future production plans of the company."^{54/}

At the time of nationalization, there is every evidence that the mining assets were in good shape. The industry had gone through a difficult time with the dislocations caused by Rhodesia's Unilateral Declaration of Independence. However, production had been rising and considerable sums were being spent on replacements.

The figures for the development work completed support this conclusion. Graph 6.15 showed that there was a decline in the amount of development work completed after 1962 but that from 1964 the trend was generally upward. In the first years of nationalization, until 1974, the amount of development work was maintained at the pre-nationalization level, but after that year it tapered off. There was a recovery in 1980, but in that year the total, of 253.4 thousand metres was still below that of the 1960s minimum of 292.3, attained in 1964. The figures taken from the company Annual Reports rather than the Mining Yearbooks, show the 1980 level of development work, of just over 250,000 metres per year, being at least maintained in 1982 and 1983, but as falling off in 1984.

The figures for the individual mines given in Tables 5.22 and 5.23 are also important. In the case of the mines that were throughout operated only by underground methods - Baluba/Luanshya, Mufulira, and Konkola - only the first saw development work after 1980 above its level of 1969. In the case of this mining complex, the development of Baluba largely accounts for

^{54/} Nchanga Consolidated Copper Mines Ltd. Annual Report 1981, page 8.

the increase in development work there between 1969 and 1973, the year in which development work reached a maximum; Stage I of Baluba was commissioned in January 1973 on schedule.^{55/} Development work at Mufulira was at a level of about 50,000 metres per year in the latter part of the 1960s, after the increase in the early 1960s caused by the development of the Mufulira West orebody, which opened up in 1962. It fell to 38.7 thousand metres in 1971, and then rose to nearly 45 thousand metres in 1974, after which it declined to a level of 30,000 metres in the early 1980s.

Konkola's development work, of about 55 thousand metres per year before nationalization, was maintained in the first years after nationalization but an unmistakable downward trend can be seen after 1977.

Of the underground/open pit mines, only Chambishi saw an increase in underground development work, but this was, of course, due to the closing down of the open pit (which finally took place in December 1978) and the opening up of the underground sections, which had first come into production in 1972. Of the two present underground/open pit mines, Nkana (Rokana) and Chingola, Rokana's underground development work fell steadily from 1969 to 1980 and since has recovered to about 50,000 metres per year, half the rate of 1969. On the other hand, underground production fell from 5 1/4 million tonnes at the time of Independence (when about all the mine's ore came from underground workings) to just over 4 million tonnes in the early 1980s. Chingola's underground production went from just below 3 million tonnes a year before nationalization to just over 2 million tonnes in 1979/80.^{56/} However, by 1983, underground production was up to 3.34 million tonnes, which exceeded

^{55/} Roan Consolidated Mines Annual Report 1973, page 5.

^{56/} Nchanga Consolidated Copper Mines Ltd. Annual Report 1980, page 37.

the previous record of 3.25 million tonnes achieved in 1960/61.^{57/} The picture, then, of Chingola's underground development is not unambiguous. Its rate was maintained quite well until 1978, when a decline set in. During this period, the rate of underground production fell, but recovered at a time when underground development, although lower than earlier levels, was described in 1982 as being on schedule^{58/} and, in 1983, as being "just below the target".^{59/} In 1983/84, however, production and development again fell back.

8.5 Financing investment in the mines

Fixed assets were only one of the companies' assets that could be built up by the injection of capital. However, as tables 5.25 and 5.27, which give the asset side of the balance sheets showed, it was the build up in fixed assets that led to the overall increase in assets between 1970 and 1981. Roan Consolidated Mines' assets went up by K390 million, of which K320 million came from the increase in net fixed assets; the comparable figures for Nchanga Consolidated Copper Mines Ltd. were K481 million for the increase in total assets and K408 for the increase in net fixed assets.

Tables 5.24 and 5.26 showed how the increase in assets, primarily mining properties, was financed. The issue of shares made little contribution. The total increase in the issued share capital and share premiums was, for Roan Consolidated Mines, K40 million between 1970 and 1981 and, for Nchanga Consolidated Copper Mines Ltd., K61 million. Moreover, these increases reflected the capitalization of the companies' debt to the government,

^{57/} Zambia Consolidated Copper Mines Ltd. Annual Report 1983, page 33.

^{58/} Zambia Consolidated Copper Mines Ltd. Annual Report 1982, page 35.

^{59/} Zambia Consolidated Copper Mines Ltd. Annual Report 1983, page 33.

effected in July 1979 for Roan Consolidated Mines^{60/} and in October 1978 for Nchanga Consolidated Copper Mines Ltd.^{61/}.

The companies built up their reserves substantially between 1970 and 1981 - by K280 million in the case of Roan Consolidated Mines and by K330 in that of Nchanga Consolidated Copper Mines Ltd.

Reserves and share capital can be considered on an equal footing in that reserves can be capitalized and new shares issued to existing shareholders. This happened in March 1982, but with retroactive effect from 1st April 1981 when Nchanga Consolidated Copper Mines Ltd. was merged with Roan Consolidated Mines to form Zambia Consolidated Copper Mines Ltd. As part of the arrangements, a total of K226 million (K32 million from share premiums and K194 million from general reserves) was capitalized and issued to existing shareholders.^{62/}

The other source of finance apart from shareholders' funds (shares, share premiums and reserves) is borrowing. Long (repayable after five years) and medium (repayable between one and five years) term indebtedness are usually treated separately from short term indebtedness (repayable within one year). They are added to shareholders' funds as sources of finance for fixed assets, investments and loans and net current assets (i.e. current assets less current liabilities, including short term debt and current maturities of medium and long term debt). The ratio of long and medium term debt to shareholders' funds gives a good indication of the financial strength of a company; of whether it has built up its assets by borrowing or by ploughing back shareholders' funds. Table 5.30 gave this ratio in its last columns. It also

60/ Roan Consolidated Mines Annual Report 1979, page 6.

61/ Nchanga Consolidated Copper Mines Ltd. Annual Report 1979, page 11.

62/ Zambia Consolidated Copper Mines Ltd. Annual Report 1982, page 5.

gave the total of short, medium and long term debt and the ratio of this amount to shareholders' funds.

Quite a close control was kept on borrowing in the years of private management until 1974 during which time, as we saw in Chapter 7.3, the minority directors of the new companies representing the former owners were required not to approve any undertaking for which the companies could not raise money on commercially attractive terms. These years were also ones of very heavy nominal and real investment in the industry. However, after 1974, total borrowing rose rapidly so that in 1977 it equalled about two thirds of the shareholders' funds of each of the companies. In 1978, it came to fully 92 per cent of Roan Consolidated Mines' shareholders' capital. In that year long and medium term loans alone were equal to almost 66 per cent of the company's shareholders' funds. In that year, too, long and medium term debt was 38 per cent (35 per cent under the new accounting system) of Nchanga Consolidated Copper Mines' shareholders' funds. Such rates were never approached in the time of private ownership. Roan Selection Trust's total borrowings were always below 16 per cent of shareholders' funds in the 1960s and the Zambian Anglo American companies' as a group were below 13 per cent.

As the companies' auditors, Deloitte, Haskins and Sells, made clear in 1978, the companies could only be considered financially viable if much of their indebtedness were to be capitalized. They added this caveat to their statements that the accounts fairly presented the picture of the state of affairs of the companies that year.^{63/} In the case of Nchanga Consolidated Copper Mines Ltd., the auditors added the extra caveat that the future profits of the company should be sufficient "to enable it to make appropriations to

^{63/} Roan Consolidated Mines Annual Report 1978, page 15, Nchanga Consolidated Copper Mines Ltd. Annual Report 1978, page 19.

Table 8.6 The capital structure of Zambia Consolidated Copper Mines Ltd.

after the merger
(K million)

Liabilities and short term indebtedness									
	Share capital	Share premiums	Reserves	Long and Medium Term Liabilities	Short term Indebtedness	Deferred Liabilities	Subordinated Borrowings	Total	
1981a/	460.8	32.1	632.1	202.1	(210.1)		..	1327.3	
1981	893.02	-	231.3	207.3	(213.8)	62.0	..	1393.6	
1982	893.0	-	57.7	405.0	(313.6)	77.2	..	1432.9	
1982b/	893.0	-	93.4	405.0	(313.6)	77.2	..	1468.8	
1983	893.0	-	34.1	544.5	(258.3)	82.9	202.6	1688.9	
1984	893.0	-	33.1	709.9	(307.3)	100.0	202.6	1872.4	
	Fixed Assets (net)		Investments Loans and advances		Net current assets		Unrealized exchange loss	Total	
1981a/	1074.3		109.8		143.1	..	..	1327.2	
1981	1173.6		14.7		205.3	..	..	1393.6	
1982	1340.6		12.2		80.1	..	..	1432.9	
1982b/	1369.1		12.2		80.1	7.2	..	1468.6	
1983	1538.0		11.6		81.5	57.8	..	1688.9	
1984	1653.0		10.6		50.4	158.4	..	1872.4	

Source: Roan Consolidated Copper Mines Ltd. Annual Report 1981; Nchanga Consolidated Copper Mines Ltd. Annual Report 1981; Zambia Consolidated Copper Mines Ltd. Annual Report 1982, 1983.

a/ These rows are the simple addition of the 1981 figures for Roan Consolidated Mines and Nchanga Consolidated Copper Mines Ltd.

b/ As restated in 1983.

capital expenditure reserve to take account of the eventual need to repay loans and other borrowings which have been used for investment in fixed assets".

In 1982, as previously mentioned, the two companies were merged with retroactive effect to April 1981. In Table 8.6 we have given the figures for Zambia Consolidated Copper Mines assets and liabilities and also, in the first row, the simple addition of the separate figures for Roan Consolidated Mines and Nchanga Consolidated Copper Mines Ltd. The reserves fell rapidly and long and medium term liabilities rose as losses mounted. As a result, the ratios of total and long term borrowing to shareholders' funds rose rapidly between 1981 and 1984. In 1982, the accountants had to add the caveat that the financial statements had been made "on the basis of the Group maintaining its operations" which depended inter alia on "the successful renegotiation of certain terms in loan agreements and the conclusion of arrangements with the Government of the Republic of Zambia for further funds to be made available from its agencies."^{64/}

8.6 Exploration after nationalization

The last aspect of the industry's performance that we will discuss is the progress of exploration. By the most simple measure - whether exploration led to sufficient new ore reserves being found to compensate for the fall in reserves caused by their extraction - the Zambian copper mining industry performed well after nationalization. The total volume of reserves rose from 750 million tonnes in 1969 to 860 million tonnes in 1982, largely through the expansion of Konkola's and Chingola's reserves (see Table 6.5). These increases more than compensated for the fall in Luanshya's reserves, as the

^{64/} Zambia Consolidated Copper Mines Ltd. Annual Report 1983, page 13.

mine approached exhaustion, and Mufulira's. However, the average grade of ore fell from 3.36 per cent copper in 1969 to 3.08 per cent in 1982 and so the amount of copper contained in the ore only rose marginally, from 25.16 million tonnes in 1969 to 26.47 million tonnes in 1982.

In 1969, the industry was operating at a profit, but in 1982 its pre-tax loss was K141.7 million, which only fell to K123 million in 1983.^{65/} As the definition of ore reserves is material that can be worked to produce the finished metal at a profit, we would have to question just how much ore reserves, or distinct from copper-containing material, Zambia in fact has. Profit and loss figures are not given for each division, but it is indicative of the unprofitability of various divisions that, as previously mentioned, in 1978, Chingola was the only one of Nchanga Consolidated Copper Mines' divisions that was operating at a profit.^{66/}

However, Zambia does have reserves which are of sufficiently high grade to render their owner a profit if efficiently worked and if the world copper price were to be at a level to allow the average producer to operate at a healthy profit.

Zambia's object in nationalizing the industry and opening up the country to new prospectors was not simply to add to the reserves of existing mines but also to introduce competition, as argued in Chapter 7.2.4. The state was not to involve itself in the risks involved in exploration but instead it had the right to acquire a 51 per cent interest in a property when it was at the production stage.

Things did not exactly work out as expected. As Table 5.31 shows, only two bodies exploring before 1970, de Beers and the Geological Survey of

^{65/} Zambia Consolidated Copper Mines Ltd. Annual Report 1983, page 20.

^{66/} Nchanga Consolidated Copper Mines Ltd. Annual Report 1978, page 3.

Zambia, a government organization, were still continuing their operations in 1982. The exploration organizations of the private companies, Zamanglo Exploration, Mwinilunga, Chisangwa and Lusaka East, had all ceased their operations by 1975.

The nationalized companies, Roan Consolidated Mines and Nchanga Consolidated Copper Mines Ltd. continued their country wide exploration after nationalization but this gradually decreased and ceased in 1978, because of economic difficulties. As we saw, Roan Consolidated Mines closed down its Geological Research and Prospecting Departments at that time. Exploration work on existing properties also suffered because of financial difficulties and such activities as well as development work were, by 1983, "reduced to an absolute minimum".^{67/}

There were new entrants after 1969, including, as Table 5.32 shows, companies from Romania, Yugoslavia, Czechoslovakia, Japan, Italy, the United States, France and the Federal Republic of Germany, and the United Nations. At first, there was a considerable amount of interest in exploration in Zambia when the private companies gave up 88 per cent of their concession areas. Yet to the enquiries of those interested in prospecting, the government's mining experts had to concede that there were very few useful deposits left untouched and even those were only marginally economic. Furthermore, it was said in 1970 that "most geologists believe that it unlikely that any large finds will be made. This is becoming obvious to newcomers."^{68/} Indeed two companies that were among the first to have shown an interest in Zambia in 1970 - the

^{67/} Zambia Consolidated Copper Mines Ltd., Statement by Mr. F. K. Kaunda, Chairman and Chief Executive to accompany Annual Report 1983, page 3.

^{68/} The Economist, February 21, 1970.

Japanese Mitsui Company and the American Continental Ore Company - did not take out a prospecting license in 1972^{69/}. Being private companies, they were perhaps less likely to be moved to invest in the country for political considerations than in the case of groups from the socialist countries.

The really interesting mineral for the newcomers turned out to be uranium, not copper. It was this mineral that attracted Saarberg-Interplan, AGIP and the Japanese. As Table 5.32 indicates, over half the identified exploration undertaken by post-nationalization new entrants, apart from state bodies, can be attributed to AGIP-Nucleare.

These new companies did not so much discover uranium as re-examine previously discovered prospects.^{70/} In 1951 and 1952, the British Atomic Energy Commission had sent a group out from Harwell which, with a geiger counter in the front seat of a Land Rover, had discovered uranium by the Zambezi River. Rhodesian Selection Trust found the other major concentrations of uranium, around Solwezi, using a scintillometer in a Rapide airplane. The Trust arranged for a London firm to investigate the area, but rejected the uranium prospects as unpromising. The Geological Survey duplicated this work in its general country-wide outcome magnetic and radiometric coverage, and AGIP went over the same ground again. At the present time, the exploration work for uranium is continuing and so it is too early to come to any conclusions as to its eventual results.

The other significant mineral development since nationalization has been the discovery of emeralds near Luanshya. However, the large area of the

^{69/} Economist Intelligence Unit Quarterly Economic Review: Zambia, No. 2, 1974, page 16.

^{70/} This section on uranium is based on a talk with W. H. Ellis, formerly exploration superintendent of RST Technical Service, in 1983.

deposits, about 1,000 km², has made it difficult to police operations and it is estimated that only 10 per cent of the output is marketed officially, the rest being mined illegally.

Some tentative conclusions can be reached from the post-nationalization period of exploration. The first is that no major new copper finds were made and no major new mines opened up. This would indicate that the private companies had indeed been quite thorough in their work of exploration. The second is that a whole new era of intensified exploration did not begin after nationalization: the initial interest soon waned. The third is that the Government did not achieve what it had hoped to from the Mines and Minerals Act, namely costless participation in the successful exploration of others: instead, it found itself assuming some of the risks of exploration. In particular, it shared the risk of exploration with Noranda and Geomin. As can be seen from Table 5.32, the Government's two parastatal exploration agencies, Mindeco and Minex, had spent by 1983 a total of K18 million, which was larger than that spent by any single outside exploration company and two-thirds of the total spent by these outside companies. Minex is exploring in the eastern part of the country which was previously closed to prospecting, and has located a new zinc occurrence, phosphates and the semi-precious metal tourmaline. It is also evaluating the phosphate potential of the Nkombwa Hill carbonatite at the north of the Luangwa valley and gold deposits.

The final conclusion is, perhaps, not very helpful: that much exploration remains to be done in Zambia. Yet this work will not be relatively cheap such as geological mapping and geophysical and geochemical sampling but rather will involve the drilling of anomalies that had been found earlier but had not been completely followed up. Only about 500,000 metres of drilling has been done outside the Copperbelt since prospecting commenced in

Zambia, which is a very minor amount compared to the amount of drilling done yearly in North America.⁷¹ However, because the rocks in Zambia contain weak zones and are weathered, the drills have to be of a much wider diameter than those used in, for example, South Africa, where the rocks are harder. Whereas a drill hole in South Africa can start with a 4 inch diameter, one in Zambia has to start at 12 inches.^{72/} Drilling will, then, be very expensive and clearly a very great incentive is needed to produce a new flurry of drilling in Zambia outside the Copperbelt.

8.7 Conclusion: the performance of the industry after nationalization

We have looked at the performance of the industry under different headings suggested both by economic theory and by the actual criticisms directed at the industry before nationalization. It was seen that, even after allowance was made for Mufulira, production did fall after nationalization. Productivity, in terms of ore and copper output per man, also fell. However the figures for accidents, except of course for 1970, the year of the Mufulira disaster which could not be attributed to nationalization, showed that progress continued to be made after nationalization. Figures for the recovery rates also illustrated that there was no drastic drop in technical performance at the mines after nationalization.

^{71/} P. V. Freeman, "Minerals found in Zambia" Mining Mirror, 25 February, 1983, page 7.

^{72/} Horizon, September 1969, page 21.

The Zambian copper mining industry was, by world standards, not a low cost producer at the time of nationalization and the position did not improve afterwards. The nationalized companies finally acted in 1977 to try to get costs under control. They were helped in containing costs by a switch towards the use of electricity and by a fall in real wages at the mines. The labour force employed at the mines continued to grow after nationalization in spite of the fall in output. Zambianization continued, but the new companies found it difficult to attract skilled expatriate labour and were not able to provide stability in the senior management.

The investment picture was one of a spurt in activity just after nationalization that soon tapered off. By the end of the period examined, the industry's capital stock was not in as good a shape as at the time of nationalization. Moreover, the companies borrowed heavily after nationalization and their asset positions were considerably weaker in 1981 than in 1970.

Finally, we saw that the Government had to help finance much of the exploration that took place in Zambia after nationalization whereas it had hoped to buy an interest in properties that had been discovered and were about to be developed. The new arrangements for exploration introduced at the time of nationalization did produce a new interest in exploration, but this soon diminished. In sum, it would be very difficult to point to any clear improvement in the industry's performance after nationalization. Surprisingly, the one clear achievement of the post-nationalization management was to hold down real wages which had risen under the private owners. This was a worth-while accomplishment in that it helped to moderate costs, but it was not a reason given for nationalization nor was it an expected consequence.

On the whole, then, the years after nationalization have not been happy ones for the Zambian mining industry. In the next chapter we will outline the performance of the industry at the macro-level, rather than at the micro-level outlined in this chapter and will then see whether the disappointments can be largely attributed to two external factors - the troubles in Zimbabwe and the fall in the copper price - that are often accorded considerable prominence.

Chapter 9

POSSIBLE EXPLANATIONS FOR THE POOR MACRO-ECONOMIC PERFORMANCE OF THE ZAMBIAN COPPER MINING INDUSTRY

9.1 The Broad Picture of the Industry's performance

9.1.1 Its contribution to national output

In Chapter 4, we gave tables for the place of the Zambian copper mining industry in the national economy. Table 4.3 showed how the industry's contribution to gross domestic product at market prices fell after nationalization. This contribution can be calculated from the income side, as the sum of the industry's operating surplus, the custom duties and indirect taxes it pays, the compensation of its employees and the amount allowed for the consumption of fixed capital.^{1/}

It can also be calculated from the output side as the value of its gross output - principally exports, but also its contribution to capital formation, and the value of the change in its stocks - less its inputs from other Zambian industries and from imports.^{2/}

Clearly, then, its contribution would change drastically if there were an adverse movement in the price of the industry's output. This can be brought out by looking at the contribution of the industry in real terms to the real gross domestic product. This is shown in Table 9.1. In this table which starts in 1971, the first year for which such figures are available, the figures for GDP in constant prices of 1970 are given in the first column and the contribution of the metal mining industry, also in prices of 1970, in the third column. The ratio of the two is given in the fourth column and

^{1/} Republic of Zambia Digest of Statistics Explanatory Notes 1965, page 13.

^{2/} vide Republic of Zambia National Accounts and Input-Output Tables 1969 May 1972 Table 16(a) and United Nations National Accounting Practices in Seventy Countries Volume III (E.79.XVII.19) New York, 1979, page 195.

Table 9.1
Zambia's Gross domestic product at constant prices of 1970
(K million)

	Total GDP Unadjusted	Total GDP Adjusted for Changes in Terms of Trade	Contribution of Metal Mining Industry	Contribution of Mining Industry to GDP (percentage)	adjusted for changes in the terms of trade
				unadjusted	
1971	1269.3	1102.6	408.5	32.2	37.0
1972	1386.4	1183.0	470.0	33.9	39.7
1973	1361.1	1312.6	440.5	32.4	33.6
1974	1473.9	1369.2	465.2	31.6	34.0
1975	1435.5	1048.3	418.3	29.1	39.9
1976	1519.4	1067.7	493.8	32.5	46.2
1977	1446.5	983.8	462.5	32.0	47.0
1978	1483.5	1004.7	487.3	32.8	48.5
1979	1369.9	1033.0	384.3	28.1	37.2
1980	1417.8	1045.0	392.2	27.7	37.5
1981	1484.0	1106.2	427.5	28.8	38.6
1982	1453.7	960.6	427.2	29.4	44.5
1983	1476.5	1045.9	464.1	31.1	44.4

Source: Republic of Zambia Monthly Digest of Statistics

shows it to have varied between 27.7 per cent, in 1980, and 33.9 per cent in 1972. This ratio was still smaller than that of the nominal ratio of the 1960s.

The ratio is higher when Gross Domestic Product in constant prices is adjusted for changes in the terms of trade. This is done by deducting the current value of exports, deflated by the index of export prices, from the current value of imports of goods, deflated by the index of import prices. This series of Gross Domestic Product in constant prices adjusted for changes in the terms of trade is given in the second column. It can be seen that the terms of trade adjustment was always negative in that the series is always smaller than that for unadjusted Gross Domestic Product. There is no breakdown of this measure of Gross Domestic Product into its industrial components as the adjustment is applied directly to the final figure for real Gross Domestic Product. A considerable downward adjustment would have had to be made to the figures for the mining industry because of its large contribution to exports and its large absorption of imports. We have not been able to do this, though, and so the figures given in the last column of Table 9.1 for the ratio of the contributions of the mining industry to Gross Domestic Product in constant prices, adjusted for changes in the terms of trade, do give the maximum that the contribution of the mining industry can be considered to have made to Gross Domestic Product. It can be seen that some of the values are not that different from those for the ratios of the industry's contribution to Gross Domestic Product in nominal terms in the 1960s of about 45 per cent, as given in Table 4.3. They were considerably higher than those shown for this nominal contribution after nationalization - of less than 20 per cent after 1974.

The preceding calculations do illustrate that the nominal figures for the contribution of the copper industry to the national economy exaggerate the

decline that took place. In real terms, the industry's absolute contribution to the national economy was greater after 1980 than it was in 1971, and by 1983 was only 6 per cent below the maximum level it achieved after 1971, in 1976. Moreover, even a fall in the share of the mining industry in the national economy is not unambiguous. If other industries, and particularly agriculture, had increased their real contribution more quickly than did the mining industry, this would surely have to be considered a positive development. The problem with the Zambian economy is that these other sectors did not grow quickly enough to keep up with population growth with the result that real Gross Domestic Product per capita was, by 1982, 20 per cent lower than in 1970.^{3/}

9.1.2 The Industry's Contribution to Government Revenue

The poor performance of the other sectors of the economy was linked to that of the mining industry in that the industry was not generating enough tax revenues to allow the Government to achieve its development objectives, nor enough foreign exchange to help finance the imports necessary for its own and other industries' development.

The figures for the mining industry's contribution to government revenue were also given in Table 4.3, and show a drastic fall in its nominal and percentage contribution. We argued in Chapter 4 that this was largely due to the erosion in the profit position of the companies as shown in Table 4.4. However, it should be pointed out that the profit figures before and after 1969 were not strictly comparable. In the first place, the nationalized companies until 1974 had to pay for the administrative and other services provided by the former owners. In the second place, largely because of the Rhokana shareholding in Mufulira, the previous groups' pre-1968 interests in the Zambian mines were different from the nationalized groups'.

^{3/} Calculated from IMF International Financial Statistics.

Finally, the taxation system was changed after 1969 and, in particular, royalty and export taxes which were previously charged to costs of sales were abolished and capital allowances were increased. Pre-tax income was henceforth larger by the amount of the difference. Roan Selection Trust calculated what the pre-tax income of Roan Consolidated Mines would have been in the years after Independence, if the new fiscal regime had applied, and the figures are given in Table 9.2. Comparing these figures with those in Table 4.4, it can be seen that, although pre-tax income (column two) would have been slightly smaller if Roan Consolidated Mines, as later constituted, had existed from 1965, the big difference was made by the change in royalty and export taxes. The management fees and increase in the capital allowances did not reduce pre-tax income by the same order of magnitude (column four). In any event, it can be seen that the pre-1969 figures understated taxable income then and, therefore, that the decline in profitability after 1969 was even more serious than appears from Table 4.4.

Table 9.2

Theoretical Results of Pre-tax Income of Roan Consolidated Mines,
1965-1969 (K mn)

	Mineral royalty and export tax	Profit before income tax	Total	Management fees	Change in taxes	Total pre- tax income
1965	27.8	37.7	65.5	1.0	0.5	64.0
1966	33.7	45.3	79.0	1.3	0.6	77.1
1967	52.0	44.5	96.5	1.2	0.5	94.8
1968	60.4	73.5	133.9	2.2	1.0	130.7
1969	64.9	99.8	164.6	2.9	1.3	160.4

Source: Roan Selection Trust Appendices to the Explanatory Statement of
Roan Selection Trust for meetings of shareholders to be held on 6th August
1970, 30th June 1970, page C-15.

Furthermore, even in the years 1970 to 1973 when the industry was making substantial profits, its contribution to Government revenue was less than it would have been if the previous arrangements had been in existence. To return to our example of Roan Selection Trust, royalties, export taxes and income

Table 9.3 Tax payments by Roan Selection Trust (Roan Consolidated Mines), 1965-1974 (K mn)

	Profits before royalties and income taxes	Royalties and export taxes	Zambian income and mineral ^{a/} taxes	Total of payments to govern- ment	Total payments to Government as percentage of taxable income
1965	64.8	22.5	18.1	40.6	62.7
1966	85.8	34.8	22.7	57.5	67.0
1967	100.5	52.0	21.2	73.2	72.8
1968	140.8	60.4	29.1	91.8	65.2
1969	170.4	64.9	37.7	103.3	60.6
		Dividends to Government			
1970 ^{b/}	108.7	7.7	69.9	77.6	71.4
1971	85.8	11.2	36.1	47.3	55.1
1972	53.7	10.5	10.7	21.2	39.5
1973	75.7	15.8	28.5	44.3	58.5
1974	222.5	22.6	144.1	166.7	74.9
1975	41.1	3.3	9.9	13.2	32.1

^{a/} Mineral taxes came into effect after 1970.

^{b/} Six months ended June 30, 1970.

Source: Roan Consolidated Mines Annual Report, Roan Selection Trust Annual Report, various years.

taxes were taking something like 70 per cent of the available profits of the companies before nationalization as can be seen from Table 9.3. With the introduction of new tax allowances designed to encourage investment in 1970, income and mineral taxes paid fell very sharply as a percentage of taxable income. Even when the Government's 51 per cent share of net dividends is added in, the Government was recovering a smaller proportion of income than in the days of private ownership. These provisions were withdrawn with effect from 23rd September 1973, and the figures for 1973/1974 do show the Government's absolute and percentage take increasing substantially. After 1974, the industry's pre-tax profits fell and in some years the companies were operating at a loss. The chance to recover such sums from the mining industry's operating surplus were not to re-occur.

9.1.3 The Industry's contribution to the balance of payments

Zambia could try to tap other sources of tax revenue to make up for what it was not obtaining from the mining industry. However, this was not the case for foreign exchange receipts where Zambia continued to rely upon the mining industry: in 1960, copper and cobalt exports came to 94 per cent of domestic exports f.o.r. and in 1980 to 96 per cent.^{4/}

The mining industry also has to import many of its components, to make payments in foreign exchange to expatriates and to pay for such services as transportation. The industry thus plays a crucial role in determining the different components of the current account balance. This balance is given in Table 9.4a which shows how Zambia has normally enjoyed a positive trade balance. Only in 1975 and 1982 did imports exceed exports. 1969, the last year of private ownership of the mines, saw the country enjoying a trade surplus of over K530 million which was never thereafter surpassed. This

^{4/} Figures from Mining Yearbooks.

Table 9.4a

Zambia Current Account Balance

(Kmn)

	A	B	C	D	E	F	G	H
	Exports f.o.b.	Imports f.o.b.	Trade Balance a/	Non-factor services (net)	Investment income (net)	Unrequited transfers (net)	Net ^{b/} Invisibles	Current account balance ^{c/}
1964	330.3	142.9	187.4	-46.1	-69.1	3.4	-111.8	75.6
1965	351.1	208.9	142.2	-31.6	-45.5	-3.5	-80.6	61.6
1966	431.4	250.5	180.9	-60.6	-58.0	-9.6	-128.2	52.7
1967	450.4	315.8	134.6	-75.7	-50.6	0.1	-126.2	8.4
1968	534.0	356.7	177.3	-103.1	-52.1	-24.9	-180.1	-2.8
1969	852.6	313.3	539.3	-102.5	-47.5	-51.0	-201.0	338.3
1970	673.2	347.7	325.5	-110.6	-33.4	-104.5	-248.5	77.0
1971	479.2	401.3	77.9	-103.0	-43.6	-107.8	-254.4	-176.5
1972	543.2	404.5	138.7	-117.3	-74.1	-96.1	-287.5	-148.8
1973	733.5	349.4	384.1	-132.6	-82.9	-80.8	-296.3	87.8
1974	898.2	509.1	389.1	-210.7	-86.9	-81.2	-378.8	10.3
1975	516.2	609.6	-93.4	-218.4	-71.6	-81.8	-371.8	-465.2
1976	742.4	482.3	260.1	-163.8	-105.8	-79.6	-349.2	-89.1
1977	700.8	532.0	168.8	-220.2	-88.1	-68.6	-376.9	-208.1
1978	665.1	494.8	170.3	-245.9	-100.4	-49.5	-395.8	-225.5
1979	1116.6	595.6	521.0	-282.2	-119.6	-83.4	-485.2	35.8
1980	1149.2	878.7	270.5	-393.7	-228.6	-138.5	-760.8	-490.3
1981	866.3	926.4	60.1	-384.2	-97.9	-114.5	-596.6	-656.7
1982	877.6	919.9	-42.3	-322.6	-227.6	-36.4	-586.6	-628.9

Memoranda: Average balances over the periods shown.

1964								
-69	491.6	264.7	226.9	-69.9	-53.8	-14.3	-138.0	88.9
1970								
-81	766.3	573.2	193.1	-223.4	-104.7	-86.4	-414.5	-221.4

a/ Column A - Column B

b/ Columns (D+E+F)

c/ Columns (C+G)

Source: Zambia Monthly Digest of Statistics and International Monetary Fund
International Financial Statistics various issues.

Table 9.4b

Zambia: The Capital account and monetary movements

(Kmn)

	I	J	K	L	N	M	Q		R	S
	Capital account	Net errors & omissions	Overall balance Monetary/ Movements	Deposit Money Banks	Foreign exchange holdings of Central Government	Foreign exchange holdings and other claims on Bank of Zambia	Liabil- ities of Central Bank	Arrears	Other	
1964	-75.7	-	-	-	-	-	-	-	-	-
1965	-52.1	2.1	11.6	-	-	-	-	-	-	-11.6
1966	-34.3	-11.4	7.0	-	-	-	-	-	-	-7.0
1967	-11.4	-12.1	-15.1	-	-	-	-	-	-	-15.1
1968	39.9	-30.2	6.9	-0.4	5.7	14.8	-26.9	-	-	-0.1
1969	-160.2	-50.6	127.5	0.1	-6.6	-46.4	-72.8	0.1	-	-1.8
1970	42.2	-11.3	107.9	-	-10.4	14.3	-104.3	-	-	-7.5
1971	31.4	-49.0	-194.1	0.1	6.8	74.2	101.2	0.1	-	11.8
1972	76.9	-39.9	-111.8	-0.2	8.4	1.6	52.9	-0.2	-	49.1
1973	-48.0	-50.3	-10.5	0.7	4.5	1.5	-7.8	-0.7	-	11.6
1974	103.2	-93.3	20.2	-0.3	-2.7	-1.7	2.7	-0.3	-	-18.2
1975	259.9	-44.8	-250.1	108.3	7.7	0.7	38.0	108.3	-	102.1
1976	39.9	-87.1	-136.4	23.0	0.3	1.2	22.1	23.0	-	03.6
1977	43.4	-59.6	-224.3	30.3	15.8	-	16.4	30.3	-	156.9
1978	35.9	-36.1	-225.3	97.6	-13.6	-0.6	12.7	97.6	-	145.3
1979	167.2	-57.2	145.8	50.8	-58.2	-	-30.3	50.8	-	40.7
1980	178.0	74.9	-234.7	50.2	55.1	-0.8	-4.1	50.2	-	107.0
1981	343.0	-42.4	-356.1	311.6	-42.9	1.1	32.5	311.6	-	46.5
1982	341.1	...	-287.8	106.0	95.4	0.2	-8.4	106.0	-	7.3
										-78.2

Source: Zambia Monthly Digest of Statistics and International Monetary Fund
International Financial Statistics

d/ Including allocation of SDR's.

Columns (H+I+J)

trade balance is primarily the balance between mineral, essentially copper, exports and imports. As can be seen from the figures, the value of imports has normally fluctuated from year to year much less than has that of exports leading to quite large year to year fluctuations in the trade balance.

The deficit on invisibles has shown a more consistent trend, increasing, on the whole, steadily over time. The main payments are for transport (non-factor services), investment income (before 1969 largely dividend repatriation and after 1970 interest payments) and transfers that expatriates have made to their home countries (included in unrequited transfers).

The figures show that there were two sharp increases in payments for non-factor services - between 1965 and 1966 and between 1973 and 1974. In both cases political events and Zambia's reaction to them, can help explain the increase: in the first case the Rhodesian Unilateral Declaration of Independence in November 1965 and in the second the closure of the border with that country in January 1973.

The bottom two rows in Table 9.4a give the average value of the different components of the current account for the periods 1964-1969 and 1970-1981. They bring out the deterioration of the invisible position as having been mainly responsible for changing Zambia's current account surplus into a substantial deficit. The value of both imports and exports of goods rose and left the trade balance, in nominal terms, only slightly smaller. However, all components of the invisible balance deteriorated sharply with that of non-factor services, essentially payments for transport, showing the greatest absolute change, of K154 million, half the overall deterioration in the current account balance of K310 million. Outflows of investment income were on average about double their pre-1969 figures in the following years, which shows that nationalization did not stem the outflow of funds abroad.

Unrequited transfers were considerably greater after 1969 than before. The transfer of contract salaries and gratuities doubled between 1968 and 1971 and then remained steady at less than K50 million.

In the early years of Independence, Zambia not only had a surplus on its current account but also was a net lender, with a net outflow in the non-monetary sector of the capital account (see Table 9.4b). After 1969, with the exception of 1973, she has had to receive inflows of funds. After taking into account errors and omissions the resulting overall balance has been negative from 1971, with the exception of 1974 and 1979. Initially this deficit was largely financed by running down foreign exchange holdings but after 1975 by increasing the foreign liabilities of the Central Bank and by going into arrears on external payments. The result of the fall in reserves and increase in external liabilities has been that the country moved from a position of having net foreign assets of K381 million at the end of 1970 to having net foreign liabilities of K682 million at the end of 1981.^{5/}

In the 1970s, the rise in the price of oil, the weakening of non-oil commodity prices, the slow growth of the developed market economies and, more recently, high interest rates have all caused severe problems for non-oil exporting developing countries. Zambia was clearly no exception.

What has been exceptional has been the relative deterioration in her position. Before the increase in oil prices she often enjoyed a surplus on her current account whereas in those years the net oil-importing developing countries as a group had a current account deficit of over 10 per cent of their exports of goods and services.^{6/} By 1982, Zambia's current account

^{5/} Bank of Zambia Report and Statement of Accounts for the year ended December 31st 1981, page 106.

^{6/} International Monetary Fund World Economic Outlook 1983, Washington, 1983, page 64.

deficit was equivalent to 67 per cent of her exports of goods and services whereas the average figure for non-oil developing countries was 19 per cent and the median figure 40 per cent.^{7/}

9.2 The Copper Market

9.2.1 Trends in the nominal and real price of copper

Exports did not make the contribution they could have to the trade and current account balances because of the fall in the volume and real price of copper. We give in Table 9.5 the price of copper on the London Metal Exchange in pounds sterling per metric ton. This was the price upon which Zambian selling prices were based except for the period January 1964 to April 1966 when the Zambian producers tried to create greater stability in price by selling at a producer's price which was expected to change less frequently than did the London Metal Exchange Price. Beside this price is given the U.S. producers' price in cents per pound as given in Metals Week.

We have calculated two indices to help show the movement in real copper prices. The first, with 1970 as 100, shows the relative movement in the London Metal Exchange copper price compared to that of the prices of a large number of commodities, both being calculated in terms of dollars. Thus, for instance, by 1975 whereas the dollar price of copper was 87 per cent of its 1970 level, the overall dollar price of commodities had risen by 174 per cent, making the relative movement a 50 per cent drop in the copper price (i.e. 87/174). This index gives an idea of copper's relative price movements against other commodities.

^{7/} International Monetary Fund World Economic Outlook 1984, Washington 1984 page 193 and International Monetary Fund International Financial Statistics (for Zambian ratio).

Table 9.5 The nominal and real prices of copper 1960-1983

Year	The nominal price of copper		Real price indices 1970=100		
	£ per tonne ^{a/}	cents/ lb ^{b/}	Copper/ Commodities ^{c/}	Copper/ Manufacturers' Export Prices ^{d/}	Copper/ Aluminium Price Ratio ^{e/}
1960	242.1	32.05	53.8	56.2	1.32
1961	225.9	29.92	52.3	51.4	1.23
1962	230.3	30.60	54.4	52.4	1.29
1963	230.6	30.60	51.2	52.4	1.29
1964	345.5	31.96	71.9	76.9	1.84
1965	460.7	35.02	97.8	100.5	2.39
1966	546.2	36.17	112.4	119.2	2.83
1967	411.4	38.22	89.2	86.7	2.09
1968	517.8	41.85	98.0	94.7	2.24
1969	610.9	47.52	107.4	107.6	2.49
1970	589.4	57.71	100.0	100.0	2.30
1971	444.4	51.43	80.4	71.2	1.73
1972	428.0	50.62	70.1	65.8	1.82
1973	726.8	58.85	76.2	93.2	2.98
1974	877.0	78.77	68.5	88.0	2.69
1975	556.8	63.25	50.9	47.0	1.42
1976	782.4	68.98	50.5	53.5	1.57
1977	750.3	66.21	38.9	45.9	1.15
1978	710.5	65.81	42.2	41.6	1.03
1979	934.1	92.21	52.8	53.3	1.23
1980	941.8	101.31	53.6	52.8	1.23
1981	865.6	84.21	49.9	44.5	1.39
1982	846.1	72.80	48.3	38.7	1.49
1983	1048.8	77.86	48.7	43.7	1.10
Arithmetic Average			67.5	68.2	1.76

Source: International Monetary Fund International Financial Statistics,
 Metallgesellschaft AG Metal Statistics, United Nations Monthly Digest of
 Statistics, World Bureau of Metal Statistics World Metal Statistics

- a/ The average London Metal Exchange Cash Settlement price of higher grade cathodes, and, prior to December 1981 wirebars.
- b/ U.S. producer cathodes, as quoted by Metals Week and, prior to 1973, wirebars.
- c/ The London Metal Exchange copper price movements compared to movements in commodity prices, lines 76 a x d and 76 c.d. in International Financial Statistics.
- d/ The copper price in International Financial Statistics (76 c.d.) compared to the United Nations' index of unit values of exports of manufactures from the developed market economies.
- e/ The ratio of the London Metal Exchange copper price and the price in the United Kingdom of 99.5% aluminium ingots and, after 1979, the London Metal Exchange price for aluminium.

The other index we have used in a similar fashion is that of the dollar price of manufactured exports from the developed market economies. The movements in the dollar price of copper against this index give an idea of the relative movements in the price of copper against the prices of goods developing countries like Zambia have to import. We have used it to help correct for the shifts in the commodity price index that would have occurred because of the rise in the price of oil.

The third column is simply the ratio of the London Metal Exchange price of copper to the price of aluminium. Aluminium is a possible substitute for copper in many uses and their price ratio is a good indicator of the strength of the copper market - for instance, if copper prices declined relative to commodity prices or the prices of manufactured exports, but still rose very strongly against aluminium, it could still be argued that the metal was being over-priced.

All three indices do, though, paint a very similar picture. The real copper price was stable between 1960 and 1963, at about half its level of 1970, and at a lower level than the average for the two decades. From 1964 to 1969, the real price strengthened, reaching peaks in 1966, when the Zambian companies finally abandoned their attempts to control the London Metal Exchange price and again in 1969. The real price declined steadily from 1969 to reach a minimum in 1977 or 1978, depending upon which index is used, but even the subsequent recovery was weak and in no way restored the copper price to its levels of the early part of the decade, nor even of the early 1960s. Copper, which in 1969 was two and a half times as expensive per tonne as aluminium was by 1983, only ten per cent more expensive. In the meantime, the real cost of producing copper, measured, as in Table 6.1 by the Kwacha costs free on rail or cost of sales less royalties and export taxes, deflated by the unit value indices of the exports of manufactured goods from the developed

market economies increased by 47 and 33 per cent respectively. The result has been disastrous for the Zambian mining industry and for the Zambian economy.

While it is clear, then, that the fall in the real price of copper did cause difficulties for the industry and prevented it from making such a contribution to the country as it had before nationalization, two questions must be addressed. The first is whether such a fall could have been anticipated and the second is whether the Zambians could have done anything to have prevented or to have mitigated it.

9.2.2 The copper market at the time of nationalization

A fall in the real price of copper could have been anticipated. The restraint on copper prices that ended in 1966 was followed by a price increase that encouraged investment in the industry. By 1969, it was clear that the prevailing high prices of copper were likely to fall. In his last Chairman's statement, Sir Ronald Prain reported that the Roan Selection Trust group's studies had indicated that refined copper consumption would increase at an average annual rate of 4.2 per cent over the following five years, whilst primary productive capacity would increase by over 6 per cent which "would appear to indicate that the supply position may be expected to ease".^{8/} As Chairman, Sir Ronald could hardly be expected to paint too pessimistic a picture and gave various reasons for expecting the market to be in balance. All in all, he argued, "it would be just as dangerous to assume substantially lower prices as it would be to believe the present price level will be maintained or increased".

Sir Ronald set out in greater detail the basis for his concern in two speeches, in 1970 and 1971. We have summarized these forecasts in Table 9.6. The first two columns give the estimates for world mine capacity that he made in 1970 and 1971 respectively. Capacity is different from production and

^{8/} Roan Selection Trust Group of Companies' "Statement by the Chairman, Sir Ronald L. Prain OBE" to accompany Annual Report 1969, page 3.

Table 9.6 The Market Economies: the actual and estimated market for copper 1970-1976
(mn tonnes)

Year	Capacity Estimates a/	b/	Estimated Mine Production ^{a/}	Estimated Total Supplies ^{a/}	Actual Mine Production	(Percentage change)	Actual Consumption Refined Copper	(Percentage change)	Commercial Stocks of Refined Copper (end of year)
1970	5.505	...	5.230	8.716	5.165	(7.0)	5.835	(1.6)	599.8
1971	5.919	5.7	5.327	8.878	5.122	(-0.1)	5.733	(-1.7)	630.3
1972	6.408	6.4	5.959	9.932	5.631	(9.9)	6.265	(9.3)	656.8
1973	6.965	6.9	6.477	10.796	6.024	(7.0)	6.927	(10.6)	393.6
1974	7.582	7.2	7.051	11.752	6.146	(2.0)	6.460	(-6.7)	832.0
1975	7.698	7.3	7.159	11.932	5.703	(-7.2)	5.432	(-15.9)	1536.1
1976	-	7.3	-	-	6.160	(8.0)	6.429	(18.4)	1671.9
Growth rate	6.9	5.1	6.5	6.5	3.0		1.6		

a/ From Sir Ronald L. Prain OBE "The Future Availability of Copper Supplies" The Institute of Metals Autumn Meeting, Amsterdam 1970, page 7 and 9.

b/ From Sir Ronald L. Prain OBE "The International Outlook for Copper" American Metal Market Forum, London 1971, page 6.

Source: World Bureau of Metal Statistics.

Sir Ronald used a factor of 93 per cent to make the conversion. Adding in secondary refined and scrap made up the total of available supplies. It will be seen that, according to his 1970 estimates, capacity and supplies were to expand by 6-1/2 per cent per annum. The 1971 capacity estimates lowered the figures from 1974 and so the growth in capacity was expected to be only just over 5 per cent. Both figures were above the historic growth rate of copper consumption of 4.4 per cent. Indeed, in 1971, Sir Ronald estimated that the market economies' consumption of refined copper would rise from 6.5 million tonnes in 1972 to 7.7 million tonnes in 1976 and, after taking into account consumption of secondary copper and net exports to the socialist countries, that demand for primary mine production would rise from 5.6 million tonnes in 1972 to 6.6 million tonnes in 1976. Comparing those estimates with the second column in Table 9.6 indicates just how serious the problem of excess capacity was expected to be.

Table 9.6 also gives figures for the actual production and consumption of copper and the levels of refined stocks over the period which would have been used by the Chairman of the nationalized companies to assess developments in the market.

9.2.3 The copper market after nationalization

It was clear at the time the mines were nationalized that the market was in surplus and that the high price was unlikely to be maintained. Mr. A. S. Sardanis, Chairman of Roan Consolidated Mines stated that "the prospects for the coming year are unfortunately not so bright. The price of copper is unlikely to reach the levels it did during the year under review. In fact, it is almost certain to remain at substantially lower levels".^{9/} In the following year, 1971, the new Chairman, Mr. Dominic C. Mulaisho argued that

^{9/} Roan Consolidated Mines, "Statement by the Chairman, Mr. A. S. Sardanis" to accompany Annual Report 1970 page 7.

"the possibility of a surplus in copper production capacity has been of concern to the industry for some years ... The surplus (in 1971) has arisen in spite of various unplanned production curtailments".^{10/} The copper surplus persisted into 1972 although the size of the surplus was described by Mr. Mulaisho as "modest".^{11/} Copper stocks only increased marginally.

By 1973, copper prices began to move up again as the situation changed from a surplus to a deficit and as the world economy went through the last burst of economic activity before the onset of the recession that was partly caused by the increase in oil prices in the winter of 1973/74. This deficit in the copper market was also assisted by several world producers experiencing production difficulties. Commercial stocks fell sharply in the year. Copper prices reached a peak in April 1974, of £1270 per tonne on the London Metal Exchange, but by the end of the year had fallen to £554 per tonne, as the recession depressed demand.

As production increased during that year, stocks expanded and continued to expand in 1975 and 1976, keeping prices depressed. The market did tighten somewhat in 1979 and commercial stocks of refined copper fell to 1090 thousand tonnes. Also, only in 1979 did nominal prices recover to their levels of 1974, but in real terms they remained substantially below their levels of that year. After 1979 or 1980, depending upon which index is used, the real price of copper fell as the increase in commercial stocks of refined copper showed that the industry was still facing a surplus in production. At the end of 1983, these stocks still stood at over 1.5 million tonnes.

^{10/} Roan Consolidated Mines "Statement by the Chairman, Mr. Dominic C. Mulaisho" to accompany Annual Report 1971, page 2.

^{11/} Roan Consolidated Mines "Statement by the Chairman, Mr. Dominic C. Mulaisho" to accompany Annual Report 1972, page 1.

It is clear, then, that the Zambians invested very heavily in the industry at a time of excess capacity - the beginning of the 1970s. By its estimates of 1971, Zambian copper production in 1976 should have stood at 900,000 tonnes as compared to 645 thousand tonnes in 1971.^{12/} This would have been a good tactic if the new capacity could have come into production at a time when the global production surplus had been removed. Yet this was not expected to happen: even in 1976, as we saw, there was expected to be a considerable excess of capacity over demand.

In 1970 or 1971, it was, understandably, impossible to predict the 1973-1974 oil shock and the subsequent slow-down in the pace of economic activity in the developed market economies. By 1975 it was clear, though, that the era of steady world growth, and therefore, of a steadily growing demand for metals, including copper, was at an end. Very considerable caution was needed by all producers in the industry and every effort should have been made to restore balance to the market.

9.2.4 Attempts to control the market

The Zambians did take part in two efforts to balance supply and demand. In November 1974, together with other CIPEC producers - Chile, Zaire and Peru - they agreed to cut their exports by 10 per cent. In April 1975, the producers agreed to cut production by 15 per cent for the period until June 1976, although Chile was unhappy with this decision. In December 1977, the CIPEC producers again agreed to a production cutback, also of 15 per cent, to be effective from March 1978.

These attempts to balance supply with demand had little apparent effect on the copper price and the Zambian producers, even at times of excess supply, have argued that they cannot cut production. The Chairman of Zambia

^{12/} Republic of Zambia Second National Development Plan, January 1972-December 1976, Ministry of Development Planning and National Guidance, Lusaka, December 1971, page 86.

Consolidated Copper Mines Ltd., Mr. F. H. Kaunda, stated in 1983 that:

"The Management critically examined the question of closure of some mines or sections thereof ... The study (concluded) that there would be no significant benefit to the Company in the short-term from closure of mines. In the long-term, however, some savings would be realised but at the risk of some mines not being re-opened. The other notable point was that the Company's ability to earn foreign exchange would be seriously impaired, with virtually no substitute source of foreign exchange from other sectors of the Zambian economy at present. For these reasons, the Company could not, literally, afford to shut down a section of the Zambian economy".^{13/}

This argument against cutting production would seem to be at variance with the position of the Zambian President, Dr. K. K. Kaunda who, at the end of 1983, called on the major nationalized producers of copper to cut back output indefinitely in the hope of boosting metal prices.^{14/} Moreover, in 1984, Mr. F. H. Kaunda wrote that "it is inevitable that some of the mines will have to eventually close" -although he appeared to be talking of a long-term perspective.^{15/}

9.2.5 Reasons for Zambia's loss of control over the market

By 1983, however, Zambia had largely lost any influence it once had on the copper market. In the 1960s, the Zambians were able to exert considerable influence on the copper market. Roan Selection Trust, in particular, was the leader in many attempts to regulate the market. In October 1960, the Trust cut production by 10 per cent and Rhodesian Anglo American cut sales by 10 per

^{13/} Zambia Consolidated Copper Mines "Statement by Mr. F. H. Kaunda, Chairman and Chief Executive" to accompany Annual Report 1983 page 4.

^{14/} Mining Journal November 11th 1983, page 338.

^{15/} Zambia Consolidated Copper Mines "Statement by Mr. F. H. Kaunda, Chairman and Chief Executive" to accompany Annual Report 1984, page 6.

cent at a time of excess supply. In July 1962, these cuts were increased to 15 per cent, and other world producers followed their lead.^{16/} However, all attempts to control the market were abandoned in 1966, at a time of excess demand, when the Chileans broke ranks, and increased their producers' prices above that of the other producers. Since that year, the important world exporters have all used the London Metal Exchange price for their sales contracts.

Even a threat by the Zambian producers to cut production did, in the past, influence the market. For instance, in July 1959, when it was producing at full capacity to make up for losses incurred in a previous strike, Roan Selection Trust threatened to cut production by 10 per cent as it felt production was out-stripping supply: the price quickly moved up by £17 to £226 per tonne.^{17/}

There would appear to be several reasons why the Zambians lost their former influence over the copper market. The first was that other producers are no longer prepared to follow them. In particular, the Chileans have insisted on maximizing their own output, arguing that they can do so as low-cost producers.^{18/} Another reason is that production decisions have not always been in the country's hands. When the country has acceded to International Monetary Fund programmes, as in 1978 and 1981, these have set out inter alia specific targets for mineral production.^{19/}

The whole question of the International Monetary Fund's adjustment policies is very complex and controversial; some of their stipulations, such that there be a devaluation, are made public, whilst other performance criteria are not set out publicly. However, there has been considerable

^{16/} Economist July 7, 1962

^{17/} Economist July 27th 1959.

^{18/} Mining Journal November 11th 1983, page 338, February 17, 1984 page 102.

^{19/} Mining Journal October 7th 1983 page 254.

criticism that the Fund has been encouraging over-production of minerals, both in its adjustment programmes which dictate that production should increase (and indeed Zambia was giving the highest priority to the expansion of minerals production after reaching an agreement with the IMF in March 1983),^{20/} and in its Compensatory Financing Facility. This Facility can be drawn on by countries which are faced with shortfalls in export revenues beyond their control. Members of CIPEC, including Zambia and Chile, have used this Facility and it has been argued that the shortfalls in revenue are not really beyond their control but are indeed a direct result of their policies of over-production which have depressed prices. Insofar, then, as the International Monetary Fund has dictated Zambia's production policies, this has weakened the country's influence over the world copper market.

One of the ways to limit production is to shut down uneconomic mines. As just mentioned, this possibility has finally been raised in 1984. However, closing a mine down temporarily does involve costs, not only in terms of the social and economic effects of making some workers redundant. If a mine is to be re-opened, work still has to be carried out to prevent collapse. Yet, the cost of this development work will not be supported by current income. For these reasons, mines have rarely been closed down - the last time a mine has been temporarily closed was in 1958/59 when Bancroft (Konkola) was closed down at a time of low copper prices and mining difficulties. Development work amounting to £1.4 million continued during the year of its closure.^{21/} It has been said that the Zamanglo group subsequently regretted closing down the mine for this year.

Restricting output need not necessarily mean the closure of mines and the laying-off of workers. Production can be reduced simply by devoting more

^{20/} Mining Journal October 7, 1983, page 255.

^{21/} Bancroft Copper Mines Ltd., Annual Report, 1959.

effort to development work, to preparing the underground workings for future production. Yet, as Graph 6.15 showed, when the price of copper fell after 1974, development work for both of the groups tailed off. By 1982, the reduction in development work had "rendered inflexible most mining operations which (was) an undesirable feature in times of unscheduled events".^{22/} It would then appear that Zambia could have made a virtue out of necessity by proclaiming it was going to cut production to balance supply with demand, and that it wanted other producers to follow suit. At the same time, it could have devoted more of its resources to development work. It is, of course, difficult to know what would have happened if Zambia had tried to resume its leading role in influencing the copper market, but it could hardly be argued that its not even attempting to play that role was beneficial to either the world copper industry or the Zambian industry.

9.3 The Struggle with Southern Rhodesia

Any threat by Zambia to alter its production would only have carried weight in the world copper market if the country had enjoyed considerable freedom of manoeuvre. For instance, a threat to cut production by 15 per cent would have carried little weight if it was well known that production would fall by that amount anyway. Indeed, in 1978, when Zambia agreed with other world producers to cut production by 15 per cent, as previously mentioned, it had to declare force majeure on a further 15 per cent of its copper shipments in May of that year because of transport difficulties.^{23/}

Such difficulties were largely a result of political factors: Zambia's response to the challenge from white-ruled Southern Rhodesia and in particular her adherence to the policy of sanctions against that country that the

^{22/} Zambia Consolidated Copper Mines Ltd. "Statement by Mr. F. H. Kaunda, Chairman and Chief Executive" to accompany Annual Report 1982, page 3.

^{23/} Mining Annual Review 1978, page 481.

international community endorsed. She paid the highest price of any country in adopting sanctions and was not fully compensated by the international community for the considerable costs incurred.^{24/}

9.3.1 Stages in the struggle

The main chronology of effects is that on November 11th 1965, the crown colony of Southern Rhodesia (hereafter Rhodesia) unilaterally declared itself independent of Great Britain. The colony had self-government where the white minority controlled all the levers of power. Zambia refused to accept anything but majority, i.e., black, rule in Rhodesia, even though it was clear that the costs to itself of opposing the Rhodesian regime would be large. Her whole economy had been dependent on links with the South. She relied upon Rhodesian Railways for her transport links, on the Wankie Colliery in Rhodesia for much of her coal supplies and on the hydroelectric station on the Southern Rhodesian side of the Kariba dam for her electricity supplies. Some of these links she could not have cut at once, - in particular, her economy would have collapsed if the Kariba electric supplies, which in 1965 amounted to 68 per cent of the country's^{25/} and 74 per cent of the Copperbelt's electric supplies,^{26/} had been interrupted. Yet Zambia was determined to cut her links with the South both to pressure the Rhodesian regime into granting majority rule and to reduce that regime's leverage on her: it was clearly unwise for her to have her economy so dependent upon a regime that was inherently hostile. There were costs involved in Zambia's action but, it must

^{24/} United Nations Economic and Social Council Assistance to Zambia: Statement made by the Co-ordinator of United Nations Assistance to Zambia on behalf of the Secretary-General, E/5867, 27 July 1976, page 9.

^{25/} Republic of Zambia Monthly Digest of Statistics, January/February 1968, page 15.

^{26/} Copperbelt of Zambia Mining Industry Year Book 1968, page 49, Kitwe.

be stated, her policy was successful in that Rhodesia achieved majority rule in June 1979 under a government headed by Bishop Muzorewa. This was not acceptable to all parties and in September 1979 a conference took place in London to arrange the terms for legal independence. In December 1979 the first stage of this was achieved with the arrival in Salisbury of a British governor, thereby ending the rebellion. Elections followed and, in April 1980, Rhodesia became independent as the Republic of Zimbabwe, with Robert Mugabe as Prime Minister.

For Zambia, there were roughly three phases of the confrontation. The first was primarily economic and lasted until January 1973 when the Rhodesian authorities closed the border with Zambia. Although the Rhodesians were prepared to re-open it to Zambian traffic the Zambians kept the border closed. This border closing took place just after the armed struggle had begun in Rhodesia, in 1972.

The Rhodesian regime initially retaliated by attacks on camps of guerrillas in Zambia and by planting land-mines along the Southern border. This phase, in which the Rhodesian forces pursued primarily military objectives inside Zambia, lasted until October 1979 when the Rhodesian government, in an effort to force the Zambian Government to use its influence with the guerrillas at the conference in London, resorted to attacks upon bridges in Zambia and to barring the shipment of maize for Zambia through Rhodesia (in October 1978 because of economic difficulties, Zambia had re-opened the border with Rhodesia). This third phase of the confrontation with Rhodesia, aimed at damaging the Zambian economy, ended in December 1979, but it took longer for the damage to be repaired.

9.3.2 The initial effects of the confrontation on the Zambian economy, 1965-1972

From the above, it can be seen that the struggle with Rhodesia involved economic dislocation rather than a massive destruction of physical plants of the sort that occurs in a conventional war: attacks on guerrilla camps and the laying of land-mines took place sufficiently far away from the Copperbelt as not to directly affect production there. Moreover, there were informal although still powerful limits to how far the Rhodesian authorities could go in inflicting economic damage on Zambia. In particular, the British explained that they were prepared to take "whatever action was necessary" if Rhodesia cut off power supplies to the Copperbelt.^{27/} As the Rhodesians did not do so, the British never had to show what sort of action they meant.

On the other hand, the Rhodesians had it in their power to make life very difficult for Zambia without actually having to resort to the type of action that would have forced the British into taking decisive military action against them. This was soon shown. In December 1965 Britain acted to bar the sale or shipment of oil to Rhodesia by British firms and, in retaliation, Rhodesia prohibited oil shipments through her territory to Zambia. An airlift was mounted by Britain, Canada and the United States from then until May 1966 to keep Zambia supplied. In September 1968 the oil crisis was essentially

^{27/} ANGLIN D. G. and SHAW T. M. Zambia's Foreign Policy: Studies in Diplomacy and Dependency. Westview, Boulder, Colorado, 1979, page 144.

over when a pipeline from Dar-es-Salaam opened. Also, after Zambia in April 1966 had decided to block payments to the Rhodesian Railways' account in Bulawayo for costs in the Zambian section of the commonly-held railway, Rhodesia Railways demanded, in May, payment in advance from Zambia for any exports from Zambia. Zambia refused to make these payments and, until the crisis was resolved at the end of July, had to find alternative outlets for her copper, including the infamous "Hell Run", the 1200 mile road from central Zambia to Dar-es-Salaam in Tanzania which was totally inadequate for the volume of traffic it had to bear. Zambia also sought to develop her own supplies of coal so as not to have to rely on the Wankie Colliery after Rhodesia sought, in the event unsuccessfully, to impose a \$5 a ton royalty on coal. By June 1966, production began at the Nkandabwe mine, and in December 1968 the first supplies of coal from the higher grade Zambian mine of Maamba were received on the Copperbelt.^{28/} In November 1971, imports from the Wankie Colliery ended. Zambian coal was, though, initially difficult to use in existing plant and so for this reason, and also because of the increase in the price of Rhodesian coal, the costs of fuel per metric ton of copper sold increased from K6 in 1964/65 to K14 in 1968/69.^{29/}

One cost of the break with Rhodesia that is hard to quantify was simply the cost of inconvenience. The links between the two countries had been very strong; businessmen in Zambia who needed a spare part or other machinery simply telephoned to Salisbury or Bulawayo to obtain it. Breaking these connections was undoubtedly one of the greatest costs of Zambia's reaction to Rhodesia's Unilateral Declaration of Independence. By about the time of

^{28/} Copperbelt of Zambia Mining Industry Year Book 1968, page 28.

^{29/} BOSTOCK M. and HARVEY C. (Eds.) Economic Independence and Zambian Copper, Praeger, New York, 1972, pages 117-120.

nationalization, at the end of 1969, these and the other shocks caused by the Rhodesian Unilateral Declaration of Independence had largely been absorbed. Deliveries to customers were virtually uninterrupted and the fuel and transport situation had improved.^{30/} The progress made by Zambia in de-linking its economy from Rhodesia can be seen from the trend in the value of imports from Rhodesia: from K71 million in 1965, equivalent to 33.7 per cent of total imports, they fell to K22.6 million in 1968, equivalent to 4.1 per cent of imports, at which level they remained until 1972 when they fell sharply to under K12 million.^{31/}

9.3.3 The closure of the border January 1973-October 1978

9.3.3.1 The importance of Rhodesia Railways

The next drastic change in Zambia's relations with Rhodesia came with the closing of the border in January 1973 which reduced the percentage by weight of Zambia's exports and imports going through Rhodesia from 55 and 69 per cent respectively in 1972 to next to nothing. In Zambia's case, import tonnages are normally higher than export tonnages and the wagon capacity required for imports is about 2.3 times that needed for exports (see Table 9.7).^{32/} A priori, then, the problems caused by the refusal of Zambia to use the Rhodesian Railways for her trade would have affected imports more than exports. As Table 9.7 shows, after the border closing in 1973, the tonnage of imports dropped sharply whilst that of exports did not. Indeed, in 1974, the

^{30/} RST Group of Companies "Statement by the Chairman, Sir Ronald L. Prain OBE" to accompany Annual Report 1969, page 1.

^{31/} Figures from Republic of Zambia Monthly Digest of Statistics, various issues.

^{32/} United Nations Economic and Social Council Assistance to Zambia, Report of the Secretary-General, 5 July 1978 (E/1978/114), Annex, page 14.

Table 9.7

Trade routes for Zambia's foreign trade^{a/}

(000 tons)

	Benguela Railway	Tanzam Railways	Tan- zanian Roads	Rhodesia Railways/ Roads	Mozambique (direct or through Malawi)	Other	Total	Exports	Imports
1970	305	-	501	1,691	24	8	2,529	848	1,681
1971	445	-	516	1,438	38	9	2,446	798	1,684
1972	314	-	412	1,331	46	8	2,111	854	1,257
1973	807	-	484	40	150	191	1,672	813	859
1974	947	-	590	-	135	234	1,906	924	982
1975	566	115	660	-	235	85	1,661	782	879
1976	135	675	571	-	212	64	1,657	898	759
1977	132	937	337	-	68	69	1,543	871	672
1978	98	856	226	136	104	51	1,471	..	..
1979	53	452	305	637	67	33	1,517	..	..
1980	46	517	365	712	8	23	1,671	..	..
1981	24	535	235	564	17	18	1,393	..	..

Source: United Nations Assistance to Zambia, E/1978/114, (5 July 1978) Annex, page 13; A/35/208, (19 June 1980) Annex, page 12; A/37/133, (7 September 1982), Annex page 16.

a/ Excluding direct trade with Zaire and oil imports which come through the Dar-es-Salaam pipeline.

export tonnage was 8 per cent greater than in 1972. Moreover, whereas traffic on the other routes was balanced before 1973, it was the Rhodesian route which carried the excess of imports over exports: in 1972, for instance, it carried 864,000 tons of Zambia's imports as against 467,000 tonnes of her exports, whereas the total difference between imports and exports was 403,000 tonnes.

9.3.3.2 The structure of exports and imports

The vast bulk of Zambia's exports are minerals - 818,540 tonnes, in 1972, the year before the border closure, of which 708,824 were exports of copper.^{33/} Zambia's import composition is considerably less concentrated than its export composition. In 1972, 42 per cent of her imports by value were machinery and transport equipment (SITC 7), 22 per cent were manufactures classified by materials (SITC 6), another 9 per cent were other manufactures (SITC 8), and 8 per cent were chemicals (SITC 5).^{34/} Only 7 per cent by value were mineral products (SITC 3). These percentages could change from year to year but the overall picture was one of a heavy concentration of Zambia's imports in manufactures. In 1980, for example, SITC 5-9 accounted for 71 per cent of imports, and SITC 7 alone for 35 per cent.^{35/} The figures for imports in weight terms bring out the same conclusion. In 1974, a year of heavy imports, manufactures classified by materials accounted for 29 per cent by weight of imports (excluding crude oil that came through the pipeline) chemicals for 27 per cent and machinery and transport equipment for 11 per cent.^{36/} As these figures show, the higher value added in machinery

^{33/} Republic of Zambia Annual Statement of External Trade 1974 Volume 1, Table 6, page 8.

^{34/} ibid. Table 1, page 2.

^{35/} Monthly Digest of Statistics. Volume XVII, Nos. 1-3, January/March 1982, page 20.

^{36/} Annual Statement of External Trade 1974, page 11.

and transport equipment means that their contribution to the value of imports is greater than that to the weight of imports.

The Zambian mining industry is heavily reliant on imports for its supplies. In 1972, 1973, 1974 and 1975, current imports into the mining industry accounted for 8.5, 9.2, 5.5 and 6.2 per cent respectively of the value of total imports, and goods for the mining industry's fixed capital formation came to 9.8, 7.3, 4.9 and 5.9 per cent respectively.^{37/} In other words, the mining industry's claim on total imports came to 18.3, 16.5, 10.4 and 12.1 per cent respectively. These figures can be compared to the 22.9, 29.8, 33.1 and 35.3 of total imports required for the manufacturing industry. The relative fall in the mining industry's claims on imports was accompanied in these years by an actual fall in the value of its imports from K73.5 million in 1972 to K72 million in 1975, whilst the value of total imports rose from K402.5 million to K597.6 million.

The value of mineral exports is much greater than these direct imports into the mining industry. However, to maintain production in the mining industry, the total volume of imports that is needed is greater than the direct inputs into the industry. A United Nations report on the country, which relied upon information supplied by the Zambian Government, estimated for 1977, when the mining industry's exports amounted to K685 million, that direct imports for the mining industry came to about K100 million but that another K130 million of goods had to be imported for industries and firms that were providing inputs for the sector and also to satisfy the consumption demands of the expatriate community working on the mines.^{38/} Approximately K230 million of imports, then, was needed to produce the exports of copper.

^{37/} Figures in this paragraph are from Annual Statement of External Trade 1975, Volume 1, Table 5, page 12.

^{38/} E/1978/114 op. cit., Annex, page 28.

The present writer has not seen figures for the weight of imports needed for the direct and indirect needs of the mining industry. However, if we assume, on the basis of the United Nations' figures, that the indirect needs of the industry are 130 per cent of the direct needs and if we use the high 1972 figure of 18 per cent of total imports for these latter needs, then the total requirements of the industry are for 41 per cent of imports. If we had used the 1975 figure of 12 per cent, then the total needs of the mining industry would have been for nearly 30 per cent of imports. Applying these percentages to the total weight of imports in 1972, the year before the border closed, would give the import needs by weight of the direct and indirect needs of the copper industry as coming to between 380 and 500 thousand tonnes. This tonnage is considerably below the weight of metal exports. Moreover, the figures are inflated in so far as they include imports of oil which came through the pipeline. If the same calculations are done with the 1977 imports that totalled K530 million and, excluding oil and direct trade with Zaire, weighed 672 thousand tonnes, then the K230 million of imports for the mining industry would have weighed nearly 300 thousand tonnes.

Clearly, this tonnage of imports was within the capacity of the transport system, certainly in 1972 before the border was closed, but also afterwards. What was required was that priority be given to imports necessary for the copper industry, and also that there should not be a sudden need to import materials to cover domestic production shortfalls. In the end such a shortfall in 1978 forced the Zambian Government to re-open the Southern border. As it explained at the time, the existing routes were too congested to enable the country to receive by planting time the 180,000 tonnes of fertilizer it needed or to dispatch the 70,000 tonnes of copper that had piled

up at the mines. The southern route was re-opened on October 6th 1978.^{39/} In early 1979, because of the bad weather, it estimated that 324,000 tonnes of maize would be needed ^{40/} and so partly for this reason the Southern route remained open. With the coming of legal independence to Zimbabwe in 1980, there was little question of the Zimbabwe route being cut again.

9.3.4 The aftermath of the closing of the border

9.3.4.1 The continuing closure of the Benguela Railway

Even so, as Table 9.7 shows, the combined tonnage of imports and exports in 1980 and 1981 was considerably below that of 1970. One reason for this was totally out of Zambia's control - the closure of the Benguela railway since 1975 to anything but traffic from Zaire as a result of the civil war in Angola. This closure reduced to next to nothing traffic to Zambia along a railway which had carried about 1,000,000 tonnes of Zambian cargo in 1974, just after the southern border was closed, and 300,000 tonnes in a more normal year, 1970. If the 1974 capacity had been available in 1981, Zambia's imports and exports could have amounted to 2.3 million tonnes.

9.3.4.2 The poor performance of the Tanzam railway

As great a disappointment for Zambia as the closure of the Benguela Railway was the poor performance of the Tanzam Railway from Kapiri Mposhi in Zambia to Dar-es-Salaam in Tanzania. This was expected to carry 65 per cent of Zambia's trade, or about 1.6 million tonnes both ways per year, the remaining 900,000 tonnes going through the Benguela Railway. Its initial capacity was estimated at 80,000 tonnes a month (960,000 tonnes a year) for exports, equivalent to 50,000 tonnes a month for imports (600,000 tonnes per

^{39/} United Nations Security Council Note Verable dated 6th October 1978 from the permanent representative of Zambia to the United Nations addressed to the Secretary-General S/12884, 6 October 1978.

^{40/} United Nations General Assembly Assistance to Zambia: Report of the Secretary-General, 30th August 1979, A/34/407, Annex, page 25

year).^{41/} The railway was officially opened in October 1975 but as Table 9.7 shows, it has not yet carried anything like the expected share of Zambia's trade - in 1981 it only carried 535,000 tonnes in both directions, less than one-third of its expected initial capacity.

The reasons for the poor performance of the Tanzam railway were discussed in considerable detail in the United Nations' reports. It should be remembered that these reports, outlining Zambia's needs for external assistance, reflected the international community's sympathy for Zambia as bearing the brunt of the confrontation with Rhodesia, and were also written with a view towards obtaining international assistance for Zambia. It was beyond the terms of reference of their authors, writing in the name of the Secretary-General, to be critical of Zambia or not to accept the Government's position that the country's problems were caused by exogenous factors. Criticism, even when only hinted at, is for that reason all the more telling.

The United Nations made it clear that the Tanzam railway was soundly constructed by the Chinese engineers: the track was generally excellent.^{42/} In 1978, the United Nations showed how an important cause of the railway's operating below capacity was that the availability of diesel locomotives was considerably below the expected level of 80 per cent.^{43/} This was compounded by a high turnaround time, i.e., the time of the round trip leaving Dar-es-Salaam, unloading and reloading at terminals--throughout Zambia and repeating the process in Dar-es-Salaam. The designed level was

^{41/} A/34/407, op. cit., Annex, page 15. The next year's report on Assistance to Zambia, 19 July 1980, A/35/208, puts the line capacity at 2 million tonnes, which would include internal traffic in Zambia and Tanzania (Annex page 22).

^{42/} E/1978/114, op. cit. Annex page 21.

^{43/} ibid., Annex, page 21.

ten days.^{44/} In 1978, turnaround time was from 35 to 45 days,^{45/} but this was only reduced to 20 days in 1982.^{46/}

In earlier years, such factors as congestion at Dar-es-Salaam and a lack of experience with operating the new equipment could be used to explain away the poor performance of the railway. However, the persistently high turnaround times and poor performance of the railway into 1982 shows that a more fundamental cause must be sought. As early as 1978 the United Nations had pointed to a serious labour deficiency. It stated that the Tanzam railway's most urgent need was seasoned staff to make proper use of the infrastructure and equipment. Proper staff was hard to recruit and harder to retain because once the railway had trained its mechanics many left for more attractive surroundings, and higher wages, on the Copper Belt.^{47/}

It should be pointed out that difficulties in obtaining qualified railway staff were not new to Zambia. Inside the country, there had been accidents caused by drunken railway engineers and even before the Tanzam railroad was opened in 1971, Zambia had sought the assistance of the Canadian National Railways to run its railways.^{48/} Zambia was, then, taking a great risk in expecting the Tanzam Railway to be operated at full capacity, although the extent of the shortfall in its performance could hardly have been anticipated.

^{44/} United Nations General Assembly Assistance to Zambia: Report of the Secretary-General, A/37/133, 7th September 1982, Annex, page 58.

^{45/} E/1978/114, op. cit., Annex, page 19.

^{46/} A/37/133, op. cit., Annex, page 22.

^{47/} E/1978/114, op. cit., Annex, page 22.

^{48/} The Economist, September 4th, 1971.

9.3.4.3 Transport difficulties and their effects on production

It is difficult to translate Zambia's difficulties with her transport routes into losses in copper production. When the border was first closed, the Government realized that production would fall below target - by 2 per cent in 1973 and by 6 per cent in 1974.^{49/} Copper production was at that time expected to expand rapidly; as previously mentioned, the Second National Development Plan for the period January 1972 to December 1976 foresaw it rising to 900 thousand tonnes in 1976.^{50/} This figure was on the high side but, even so, falls of 2 and 6 per cent below a target of, say, 850,000 would not have brought production to the low levels they actually reached. A further illustration of this is that Nchanga Consolidated Copper Mines Ltd., which, unlike Roan Consolidated Mines, did not have to contend with the effects of a mine disaster, in mid-1974 planned for its production to increase to a rate of 500,000 tonnes per annum by 1975 as compared to 440,000 tonnes achieved in the year ending 31st March 1973.^{51/}

We would not, then, hold transport problems alone responsible for the production and other difficulties the Zambian copper mining industry faced. However, these difficulties exacerbated the transport problem by not providing the mines with the revenues, particularly foreign exchange revenues that could have been used to help overcome them.

^{49/} Statement on behalf of the Secretary-General by Sir Robert Jackson, Co-ordinator of United Nations' Assistance for Zambia, 17th July 1973. Mimeographed page 5.

^{50/} Republic of Zambia, Ministry of Development Planning and National Guidance Second National Development Plan January 1972-December 1976, December 1971, page 86.

^{51/} Nchanga Consolidated Copper Mines Ltd., Chairman's Statement 1974 and Annual Report 1974, page 11.

9.4 Foreign exchange shortages and their effects

9.4.1 Currency devaluation

In January 1973, when Zambia refused to re-open the border with Rhodesia the copper market was, on the upswing, the cash price of electrolytic copper stood at £475 per tonne and by the end of the year had reached £960. The peak was reached in April 1974 after which the price fell quickly. Except for a brief revival in 1979 and 1980 the price has remained depressed since 1974 and by 1982 very few copper producers in the world were operating at a profit. It was calculated that in the first half of that year, copper in the non-Communist countries was being produced at an average loss of 17 cents per pound,^{52/} whereas copper was selling at about 80 cents per pound.

Zambia is heavily dependent upon imports for her development programmes and, as previously mentioned, the copper industry itself requires substantial expenditures of foreign exchange. On top of the K230 million estimated in 1977 as being required for imports of goods, the United Nations estimated that an additional K80 million would be required to allow expatriate personnel to transfer savings and service gratuities, and a further K100 million to pay the transport costs for exports.^{53/} A total of almost K410 million of foreign exchange was then needed simply for the copper industry's needs, compared with foreign exchange earnings by the copper industry of K 685 million in 1977.

The Zambian Government has resisted allowing the Kwacha to be devalued in line with the fall in the price of copper or even with the increases in its production costs. This would increase the receipts of the copper industry but would add to its costs and, more generally, to those of other industries. For

^{52/} Mining Journal, October 15, 1982, page 271.

^{53/} E/1978/114, op. cit., page 28.

this reason, the currency had, until 1984, only been devalued in 1976, 1978 and 1983, and the International Monetary Fund had insisted on those devaluations as part of its assistance packages. The net result has been that whereas the average copper price realised in dollar terms fell from \$1717 per tonne in 1973/74 to \$1653 in 1981/82, or by 3.9 per cent, the Kwacha price increased from K1444 per tonne to K1522, or by 5.4 per cent.^{54/} In the intervening period the average cost of sales almost trebled from K659 per tonne in the case of Roan Consolidated Mines and K694 in that of Nchanga Consolidated Copper Mines Ltd. to an average of K1900 in 1981/82.

9.4.2 Foreign exchange shortages and their effects

Faced with the tightening squeeze between stagnant copper prices and rising costs, the Zambian industry attempted to contain costs and, more dubiously, to increase production so as to improve revenue and, therefore, foreign exchange receipts. It was not able to increase production and one of the reasons given was precisely the foreign exchange shortage and accompanying payments arrears. The foreign exchange shortage meant that local suppliers were not always able to make available essential inputs for the mining industry,^{55/} which led to acute shortages of spare parts. Payments arrears induced foreign suppliers to insist upon payment in foreign currency before shipping goods to Zambia.^{56/} Furthermore, substantial sums were owed

^{54/} Zambia Consolidated Copper Mines Annual Report 1982, pages 26 and 34, Roan Consolidated Mines Annual Report 1981, pages 26 and 34. (The figures for 1974 are only for Roan Consolidated Mines).

^{55/} Roan Consolidated Mines Annual Report 1978, page 6.

^{56/} New Africa, May 1978, page 145.

for port charges on Zambian cargoes and clearing agents had to wait for payment.^{57/} As recently as June 1983, copper shipments from Zambia were being held up at Kapiri Mposhi because Zambia had not paid the port authority at Dar-es-Salaam. After the Government cleared part of this debt, copper shipments were expected to resume. At that time a backlog of copper worth about K180 million had built up.^{58/}

Another consequence of the shortage of spare parts was that vital equipment at the mines had to be partially dismantled to supply components needed elsewhere.^{59/} Moreover, the companies had to build up larger inventories of stores as the delivery time for imports had lengthened considerably - from six months in 1968 to almost 2 years in 1978. As a result, the costs of maintaining the required inventory for the mining sector had increased from K20-30 million to almost K200 million in the same period.^{60/}

9.4.3 Shortages of skilled labour

One other consequence of the foreign exchange shortage and of the consequent unavailability of many domestic imports and of the difficulty in repatriating income was that it became more difficult to recruit and retain skilled expatriate personnel. We mentioned in the previous chapter how the expatriate labour force declined sharply after Independence and after nationalization. This was partly because of Zambianization but also partly

^{57/} E/1978/114, op. cit., Annex, page 27.

^{58/} Mining Journal, June 17th 1983, page 416.

^{59/} Financial Times, 10 January 1979, page 3.

^{60/} E/1978/114, op. cit., Annex, page 29.

because the country could not recruit expatriate labour of the required caliber. The last report of the United Nations, in September 1982, described how the fall in production was due to "deteriorating ore grades, shortages of skilled manpower, labour unrest, and recurring shortages of spare parts."^{61/} However, so great were the problems of the industry by then, and so desperate was the need to cut costs that Zambia Consolidated Copper Mines was at the same time embarking upon a policy "to enable it to retain long serving and highly experienced expatriates and, when necessary, to recruit a better quality of expatriate with the result that the Company will be able to do with fewer expatriates than hitherto."^{62/} In fact, the Company embarked upon a policy of reducing the expatriate complement by 500, or by roughly 25 per cent.

9.5 Summary and conclusion: the consequences of external factors

From the preceding description, it can be seen that the period since Rhodesia's Unilateral Declaration of Independence in November 1965 has, almost without respite, been one when the Zambian copper mining industry has had to face severe difficulties, many of them caused by the conflict with Rhodesia or the collapse of the copper price. Transport difficulties, foreign exchange

^{61/} United Nations General Assembly Assistance to Zambia: Report of the Secretary-General, A/37/133; 7 September 1982, Annex, page 9.

^{62/} Zambia Consolidated Copper Mines Ltd. "Statement by Mr. F. H. Kaunda, Chairman and Chief Executive," to Accompany the Annual Report 1982, 8th October 1982, page 4.

shortages, skilled manpower shortages and unavailability of spare parts have drastically affected the operations of the industry.

Our review of the different problems shows that not one can explain the disappointments in the performance of the industry after nationalization. For example, the transport problems were not such as to explain the decline in copper production: the capacity was there to ship out the copper and indeed, in the pre-nationalization period from 1965 to 1969 some copper was sent out of the country by air. Shortages of foreign exchange were often very grave, but it would be difficult to see why they could explain the steady fall in labour productivity: at times of stringency it might be thought that the less profitable mines should have been closed down, thereby causing average productivity to rise.

Yet Zambia's problems were not so much caused by a series of clearly separable shocks but rather by sporadic problems occurring over a long period of time and frequently reinforcing each other - for instance the transport difficulties were considerably aggravated by shortages of foreign exchange. It would be difficult to capture and to separate in a regression analysis the effect of these shocks.^{63/} From time to time, estimates were made by the companies of the amount of production that would be lost as a result of the various difficulties. For instance, in 1979, their chairmen estimated that unless foreign currency were made available and foreign experts were found and retained, production should fall by 83,000 tonnes below the 656,000 tonnes estimated to have been produced in 1978.^{64/} (In the event,

^{63/} cf. NZIRAMASANGA M. and OBIDEGWU C. "An Econometric Model of the Impact of the Copper Market on the Economic Development of Zambia", Wharton Econometric Associates Inc., March 1979, page 13.

^{64/} Mining Journal, January 12th 1979, page 30 and Financial Times, January 10th 1979, page 3.

production in 1979 was 55,000 tonnes below that in 1978). The present writer has not seen any estimates that actually break-down the shortfall of production into, say, losses caused by transport difficulties, shortages of spare parts, lack of expatriate skills and difficulties in working lower grade ores.

Even if such an estimate were made it would not really answer the central question which is not whether or by how much these difficulties affected production. It is rather whether, given the events that did take place and that would have taken place even if the private owners had remained in control of their properties, they could have been expected to have faced these difficulties better than did the Government-run concerns and to have operated the industry so that it would make a greater contribution to the country. Some of these difficulties were clearly outside the Zambian Government's control and could not have been foreseen. For instance, the collapse of the Portuguese Empire in Africa and the closing of the Benguela Railway could certainly not have been foreseen at the time of nationalization. On the other hand, many of the factors mentioned could at least have been foreseen. This was the case with, for instance, the fall in the price of copper after 1970, although it would be difficult to argue that the extent and duration of the past 1974 collapse could have been anticipated. The failure of the Tanzam Railway to live up to expectations has clearly caused Zambia severe difficulties but in this case it could not be argued that this could not have been anticipated. Zambia's experience in running her own railways was not very encouraging and it was very dangerous for the country to put so much confidence in an untested railroad.

In the matter of the availability of skilled labour, the question is complex, but it certainly cannot simply be argued that the Government was unlucky that the price of copper fell, thereby making it more difficult to pay attractive salaries. We have to ask whether it was more likely that expatriate labour would have stayed with the companies before as opposed to after nationalization and, secondly, whether the cancellation of the management contracts aggravated or alleviated the problem. Moreover, other decisions that Zambia took at about the same time had a direct effect on the manpower problem. This was particularly the case with the closing of the border with Rhodesia in 1973. As the United Nations pointed out "An invisible cost (of Zambia's closure of the border with Rhodesia) - but one of incalculable importance - has been the diversion, in a chronic condition of scarce manpower resources, of so much of the time of everyone in the Government ... away from the nation's internal problems to those which demanded immediate action as a result of the emergency situation."^{65/}

Not only was the time of existing government officials diverted by the crisis but also skilled labour shortages were caused by the new demands caused by the crisis: we saw earlier how the operations of the Tanzam railway were affected by the mechanics employed in Zambia leaving for the higher wages and more attractive surroundings of the Copperbelt.^{66/}

The important question about nationalization is, then, whether the Government was correct to assume the responsibilities and risks of owning and, later, running the industry in an environment made even more uncertain by changing conditions in Rhodesia and the copper market.

^{65/} E/5867 op. cit., 27 July 1976, page 7.

^{66/} E/1978/114 op. cit., Annex page 22.

Chapter 10

ECONOMETRIC TESTS OF EFFICIENCY

Throughout our earlier discussion, we have drawn attention to problems with the available data and have tried to take these into account when examining whether the performance of the industry changed after nationalization. In this chapter, we will perform some econometric work on the data and test whether there was any statistically significant change in the performance of the industry after as opposed to before nationalization.

10.1 Cobb-Douglas Production Function Tests

The first set of tests will deal with the efficiency of the industry as measured by how capital and labour were combined to produce an output in terms of finished copper or copper ore. For these tests we first used a Cobb-Douglas production function of the type.

$$(a) Q = A K^{b_1} L^{b_2} e^{rt}$$

when Q denotes output, A is a constant term, K the capital stock, L the labour force and e^{rt} a term to take account of technical progress which is assumed to be disembodied and a function of time.

For the purposes of our analysis, output was either the output of copper given in Table 5.2, Q_1 ; or the tonnage of ore mined, Q_2 , as given in Table 5.4, but with the 1981 figure adjusted. We estimated the capital stock, K , in four different ways in the course of our earlier discussion. In Table 6.3 we deflated the nominal capital stock, the net fixed assets, by the wholesale price index for goods for fixed capital formation from 1966 to 1981 and by the wholesale price index for all building materials from 1960 to 1965. We combined the figures for RST/RCM and Zamanglo/NCCM to give K_1 . We also used the GDP deflator, adjusted for changes in the terms of trade, and this measure

of the capital stock is labeled K_2 . The net fixed assets of the groups were also deflated by the unadjusted GDP deflator and this measure of the capital stock is labelled K_3 .

Finally, in Table 6.4, we gave another measure of the capital stock in which the increments in net fixed assets were deflated by the price index for investment goods used for K_1 and added to the 1959 measure of the capital stock. This measure is called K_4 .

These four measures of the capital stock are given in Table 10.1.

Table 10.1 Measures of the Net Capital stock at constant prices, 1960-1981
(Km)

	K_1	K_2	K_3	K_4
	(1971)	(1971)	(1971)	(1960)
1960	325.4	341.4	363.3	224.9
1961	353.9	384.1	414.1	245.0
1962	373.8	408.0	433.9	259.5
1963	383.4	414.6	441.2	270.1
1964	379.9	418.9	445.7	280.1
1965	375.1	400.2	425.8	291.6
1966	357.0	391.3	351.4	297.9
1967	356.3	377.8	341.9	308.6
1968	356.7	355.4	317.9	309.9
1969	381.5	405.4	287.0	329.9
1970	411.8	406.7	353.5	349.6
1971	439.9	439.9	439.9	388.7
1972	459.6	476.0	486.6	428.4
1973	494.0	518.6	464.3	473.1
1974	493.8	507.9	472.3	513.3
1975	454.6	521.5	616.4	546.7
1976	370.7	476.5	588.8	566.3
1977	315.8	453.9	579.8	582.1
1978	261.3	433.9	558.6	593.5
1979	226.4	382.9	441.5	596.7
1980	210.0	358.6	411.2	611.6
1981	211.8	364.3	443.9	616.3

Source: Tables 6.3 and 6.4

On a priori grounds we would expect the best measure of the capital stock on constant terms to be the one where the nominal figures were deflated by an index of the price of investment goods, rather than by more general indices like the GDP deflators that exclude the effect of import price changes, especially as much of capital equipment was imported. Thus we would expect K_1 to give better results than K_2 or K_3 . The method of calculating K_4 was different, and was such that the capital stock appears to increase over time.

For the labour force, we used the figures for total labour strength given in Table 5.6. We did not then take account of changes in the quality of the labour or of the amount of hours worked, as these latter figures were not available.

To take into account the effect of nationalization, we used a Dummy variable D_1 , which had the value of 0 from 1960 to 1969 and 1 from 1970 to 1981.

The production function was then in the form:

$$(b) \quad Q = (Ae^{D_1 b_3}) K^{b_1} L^{b_2} e^{rt}$$

where, as $e^0 = 1$, $Ae^{D_1 b_3}$ was equal to A in the years before nationalization. In this form, the marginal productivities of capital and labour remained constant, but what was shifted was the whole production frontier. If e^{b_3} was greater than 1, it would mean that for the same combination of capital and labour, output would have been greater after nationalization than before. This fits in with our earlier discussion of efficiency: that an industry could be considered to be run more efficiently under public rather than private ownership if, using the same inputs, it invariably produced a larger output.

10.1.1 Results for the unconstrained production function

Equation (b) in log linear terms is:

$$(c) \log Q = \log A + b_1 \log K + b_2 \log L + rt + b_3 D_1 u_t$$

The last term, u_t , was the error term. They were assumed to have an expected value of zero, to have a common variance, to be independent of the dependent variables, and to be mutually independent. Under these assumptions, ordinary least squares provides the best linear unbiased estimator.

Equation (c) was estimated by ordinary least squares, using the two output measures and the four capital stock measures, giving eight equations in all. Throughout this chapter, equations have been examined for autocorrelation using the Theil-Nagar ^{1/} test. Where there was evidence of positive autocorrelation at the 5% level, the equations were re-estimated by the Cochrane-Orcutt method ^{2/}, assuming a first-order autoregressive scheme. Such re-estimated equations have been denoted by an asterik (*). Figures given in brackets are the 't' statistics.

Only the two equations using K_1 gave statistically significant coefficients for the capital stock, and these two equations are given below:

Table 10.2

Results for the Cobb-Douglas production function

(1) $\log Q_1$	=	8.68	+ 0.37 $\log K_1$	- 0.42 $\log L$	+ 0.024t	- 0.13D ₁
		(2.50)	(6.77)	(-1.29)	(3.77)	(-2.78)

$$D.W.=1.82 \quad R^2 = 0.75$$

(2*) $\log Q_2$	=	14.39	+ 0.57 $\log K_1$	- 0.74 $\log L$	+ 0.052t	- 0.16 D ₁
		(3.28)	(7.03)	(-1.75)	(5.58)	(-2.53)

$$D.W. = 1.95 \quad R^2= 0.91$$

^{1/} THEIL H. & NAGAR A.L. "Testing the independence of regression disturbances" Journal of the American Statistical Association, 1976, pages 793-806.

^{2/} COCHRANE D. & ORCUTT G.H. "Application of Least Squares Regressions to Relationships containing Autocorrelated Error Terms" Journal of the American Statistical Association, 1949, pages 32-61.

It was argued earlier that K_1 was, on a priori grounds, the best estimate of the capital stock. It was also understandable how the coefficients for the labour input, although not strictly significant at the 5% level, were negative. Over the whole period, the labour force rose while the output of ore and copper eventually stagnated and then fell. This would indicate that the larger labour force was working at a low degree of intensity and producing less output. It is also likely that changes in the quality of the labour force were important - that although the total numbers employed rose, the average productivity of the labour force fell.

We next explored whether some other important influences had been overlooked. We tried to gauge the effect of the Mufulira disaster by introducing another Dummy variable, D_2 , which had the value of 1 in 1970 and 1971. However, this dummy variable will also pick up another factor present in the immediate post-nationalization years, - the management contracts that the Zambian Government decided to terminate in 1973. It is possible that the continuation in their management role of the former private owners of the mines had a positive effect on efficiency, which outweighed the influence of the Mufulira disaster, and this would show up by a positive sign on the D_2 variable in the regression equations.

In Chapter 8.1.1 we saw that the effects of the Mufulira disaster and the subsequent need to sand-fill were limited, and certainly could not account for any major deterioration in Zambia's overall performance after the middle of the decade. Thus a large and negative sign on the dummy D_1 cannot be solely attributable to the Mufulira disaster and its effects. This consideration also holds for the cost functions estimated later in the chapter. We also introduced in our equations the grade of ore mined as another variable, to

represent the physical characteristics of the orebody - a fall in the grade of ore could have meant greater difficulties in extracting the ore, which would have reduced production. However, this variable proved statistically insignificant when included in the equations and it did not improve the overall goodness of fit. Thus equations with the ore variable are not shown. Again, only K_1 as a measure of the capital stock was used. The results when D_2 was introduced are given below:

Table 10.3

Results for the Cobb-Douglas production function,
with allowance made for 1970 and 1971

$$(3^*) \log Q_1 = 6.87 + 0.41 \log K_1 - 0.28 \log L + 0.028t - 0.19D_1 + 0.046D_2$$

$$(1.68) \quad (7.70) \quad (-0.72) \quad (4.14) \quad (-3.15) \quad (0.93)$$

$$D.W. = 2.12 \quad R^2 = 0.75$$

$$(4^*) \log Q_2 = 11.61 + 0.58 \log K_1 - 0.49 \log L + 0.052t - 0.22 D_1 + 0.066D_2$$

$$(2.38) \quad (7.84) \quad (-1.05) \quad (6.15) \quad (-2.86) \quad (1.12)$$

$$D.W. = 2.17 \quad R^2 = 0.92$$

It is noticeable that the significant coefficients were reasonably stable with the addition of the D_2 variable. Again the labour coefficients were insignificant. The D_1 dummies were negative and significant. The D_2 dummies were not strictly significant at the 5% level - their positive sign perhaps being tentative evidence that the effects of the management contracts were beneficial and more than offset the harmful results of the Mufulira

diasaster. However it is the case that the sum of the coefficients of D_1 and D_2 was negative in both equations, indicating that efficiency was impaired by nationalization, but that the degree of impairment was mitigated by the retention in their management role of the former private owners of the mines.

The effect of the change in the ore grade over time was probably picked up by the time variable, such that the coefficient of this term reflected both technical progress and the falling ore grade. This is consistent with the coefficient of the time term being lower in the copper output (Q_1) equations than in the ore output (Q_2) equations.

10.1.2 The constrained production function

Further exploration regressed output per head against capital per head. This can be looked at as imposing constant returns to scale on a production function (i.e. that $b_1 + b_2 = 1$ in equation b). It is a useful test in that we would like to know whether capital per worker was used as productively after nationalization as before and this regression does provide a test for this. If nationalization led to excessive use of labour, with the labour force being expanded beyond its strict economic necessity, then we would expect the returns per unit of capital for each worker to be lower.

The equation for this new regression was

$$(d) \quad \frac{Q}{L} = A \left(\frac{K}{L} \right)^{b_1} e^{rt} \cdot e^{b_2 D_1} \cdot e^{b_3 D_2}$$

Therefore:

$$(e) \quad \log \frac{Q}{L} = \log A + b_1 \log \left(\frac{K}{L} \right) + rt + b_2 D_1 + b_3 D_2$$

The last two terms disappeared when D_1 and D_2 were equal to zero. When they were both equal to 1, in 1970 and 1971, then b_2 and b_3 could be combined so that:

$$(f) \frac{Q}{L} = A \left(\frac{K}{L} \right)^{b_1} e^{rt} e^{b_2 + b_3}$$

The results for K_2 , K_3 and K_4 were as disappointing as in the previous regressions that tested the unconstrained production function. The results for those equations that included the log of the ore grade as a variable have not been given, as the coefficients for this variable were never statistically significant.

The results are given below with equations where D_2 was omitted being shown first:

Table 10.4

Results for the constrained production function

$$(5^*) \log Q_1/L = -2.61 + 0.36 \log K_1/L + 0.0086t - 0.13 D_1$$

(-5.96) (3.65) (1.041) (-1.82)

$$DW = 1.88 \quad R^2 = 0.81$$

$$(6^*) \log Q_2/L = 1.77 + 0.53 \log K_1/L + 0.032t - 0.13 D_1$$

(3.43) (4.53) (3.28) (-1.69)

$$DW = 1.50 \quad R^2 = 0.77$$

$$(7^*) \log Q_1/L = -2.59 + 0.37 \log K_1/L + 0.014t - 0.21 D_1 + 0.092 D_2$$

(-9.04) (5.82) (2.42) (-3.32) (1.93)

$$DW = 2.09 \quad R^2 = 0.83$$

$$(8^*) \log Q_2/L = 1.96 + 0.58 \log K_1/L + 0.044t - 0.28 D_1 + 0.14 D_2$$

(5.78) (7.57) (5.85) (-3.80) (2.59)

$$DW = 2.06 \quad R^2 = 0.82$$

The equations with D_2 appear more satisfactory than those without, indicating that these equations are better specified. In particular, equation (5*) indicates insignificant coefficients for time and for D_1 , while (6*) still exhibits positive autocorrelation, despite being estimated by the Cochrane-Orcutt procedure. We will therefore concentrate on equations (7) and (8*).

It will be noted that equation (7) was estimated by ordinary least squares and that for both it and equation (8*) the capital/labour coefficients were reasonably stable after the addition of the D_2 variable. The results were also consistent with those for the unconstrained production function - D_1 was again significant and negative and of the same order of magnitude. D_2 was positive, and, in these equations, significant. Moreover, the sum of D_1 and D_2 remained negative.

10.2 Tests on the costs of production

The second part of our testing of the efficiency of the industry after nationalization concerned looking at whether costs changed. Once again, we had problems with the data, particularly as the Zambian Anglo American group did not give such detailed cost figures as did the Roan Selection Trust group. The former only gave "cost of sales" which is not very helpful, as it could have changed through factors completely out of the mining companies' control such as transport costs, and royalties and export taxes which were quite large compared to costs free on rail (f.o.r.) at the mine. Unfortunately, only Roan Selection Trust published these figures before nationalization, whereas both groups published them afterwards. We have, then, used the Roan Selection Trust figures for the years before nationalization and a weighted average of the two groups' figures for the

years afterwards. We give in Table 10.5 the relevant figures. It can be seen that, during the period 1971 to 1981, although for individual years the cost figures differed, on the whole both series showed a similar order of magnitude - only K19 per tonne separated them in 1981 and K2.2 per tonne in 1971. It did not, then, appear unreasonable to use the Roan Selection Trust figures to represent the years before 1970. Moreover, there was not a dramatic increase between 1969 and 1970 which could have called into question all our results.

Table 10.5 Costs f.o.r. mine at the Zambian Mines, 1961-1981

	<u>RST/RCM</u>	<u>ZCCM</u>	<u>Weighted average</u>
1961	250.1	--	
1962	241.7	--	
1963	242.7	--	
1964	219.3	--	
1965	228.6	--	
1966	265.1	--	
1967	329.2	--	
1968	307.8	--	
1969	313.1	--	
1970	339.6	..	339.6
1971	412	409.8	410.7
1972	448	454	452
1973	464	443	451
1974	523	531	528
1975	619	667	647
1976	680	731	697
1977	806	752	772
1978	809	950	891
1979	908	984	953
1980	1213	1143	1171
1981	1380	1399	1392

Source: Roan Selection Trust, Roan Consolidated Mines, Nchanga Consolidated Copper Mines Ltd. Annual Reports, and Table 5.10.

The general equation that was used was

$$(g) \quad C = A B^{b_1} C^{b_2} D^{b_3} e^{b_4 D_1} e^{b_5 D_2}$$

where C = costs f.o.r. mine

A = constant

B, C, D = different independent variables, as described below

D_1 = Dummy variable = 0: 1961...1969; 1: 1970-81.

D_2 = Dummy variable = 0: 1961...1969, 1972...1981; 1: 1970, 1971

Therefore

$$(h) \quad \log C = \log A + b_1 \log B + b_2 \log C + b_3 \log D + b_4 D_1 + b_5 D_2 + u_t$$

It will be seen that this formulation implies that nationalization affected only the constant term. After nationalization, this constant term became Ae^{b_4} or $Ae^{(b_4+b_5)}$, rather than simply A. It was, then, as if the whole cost curve moved, rather than that the response of costs to movements in variables B, C or D changed.

Many independent variables suggested themselves, and we used several, in different combinations. These were

LPCF = log of index for prices of goods for fixed capital formation

LPEL = log of wholesale price index for electricity

LPMX = log of unit value of manufactured exports from developed market economies, converted from dollar to Kwacha terms

LPDU = log of wholesale prices of domestically used goods

LAV = log of average earnings in the mining industry

LPI = log of index of earnings of P1 workers

LPII = log of index of earnings of P11 workers

LLPT = log of labour costs per tonne of copper

LQ1 = log of finished copper production in Zambia.

LQ2 = log of ore output in Zambia

LOG1 = log of ore grade milled in Zambia

The first letter L indicated that the log was being used.

The mid-points in the yearly salary scale for the P1 and P11 workers were used when applicable. It will be noted that wage rates are different from average earnings or labour costs per tonne in not taking account of bonuses and other payments or the movement of workers into higher grades.

Several of these variables have been given earlier in the text, and were simply used in index form in the regressions. AV (average earnings) were given in Table 5.14, first column; LPT (labour costs per tonne) in Table 5.13; Q_1 (copper output) in Table 5.2; Q_2 (ore output) in Table 5.14 and OG1 (ore grade) also in Table 5.4. The other variables are given in Table 10.6.

Table 10.6 Variables used in cost equations

	PCF	PEL	PMX	PDU	PI	PII
1960	81.7	102.9	94.0	81.7	-	-
1961	81.9	102.7	96.0	81.9	52.5	53.4
1962	82.1	101.7	96.0	82.1	61.1	58.5
1963	83.4	100.3	96.0	83.4	57.9	55.4
1964	87.5	99.2	98.0	87.5	71.8	78.0
1965	92.7	99.3	100.0	92.7	71.7	78.0
1966	100.0	100.0	100.0	100.0	100.0	100.0
1967	104.7	107.3	102.0	103.8	100.0	100.0
1968	105.2	115.8	102.0	111.0	100.0	100.0
1969	106.4	102.2	106.0	113.6	100.0	100.0
1970	109.0	95.7	110.3	116.4	110.8	102.8
1971	118.2	91.4	118.3	123.1	110.8	102.8
1972	129.3	93.6	126.6	133.9	110.8	102.8
1973	138.4	88.9	135.4	141.2	122.3	116.8
1974	156.9	85.6	163.7	161.7	122.3	116.8
1975	190.8	84.0	183.7	188.6	140.6	131.4
1976	253.4	86.9	203.7	221.6	146.1	138.8
1977	320.6	83.5	246.0	276.2	154.3	143.3
1978	413.6	79.7	285.7	330.2	154.3	147.7
1979	487.3	79.1	321.7	381.9	176.3	155.0
1980	544.8	77.4	356.0	424.2	198.3	161.2
1981	599.5	78.1	369.7	475.9	231.1	170.3

Source: Zambia Monthly Bulletin of Statistics, United Nations Monthly Bulletin of Statistics (for PMX).

The price data for Zambia are very sparse in the early years, before 1966, and so the figures for all building materials were used from 1960 to 1965 when calculating the indices for the prices of goods for fixed capital formation (PCF) and of domestically used goods (PDU). However, these years were ones of low inflation - consumer prices rose by just over 20 per cent between 1960 and 1966, the same rise recorded in the prices of building materials. Before 1966, the consumer price index for fuel and light was used instead of the wholesale price index for electricity. We give some of our results in Table 10.7, equations 9* to 14*. It can be seen that most of the regression coefficients are significant.

Table 10.7 Regression results when costs at mine per tonne (C) were the dependent variable (1961 - 1981)

(9*) $\log C = 1.42 + 0.57 \text{ LPCF} + 0.35 \text{ LPI} + 0.17 \text{ D1}$ (2.84) (6.62) (2.01) (2.84)	DW=2.00 $R^2=0.98$
(10*) $\log C = 1.58 + 0.52 \text{ LPCF} + 0.37 \text{ LPI} + 0.24 \text{ D1} - 0.11 \text{ D2}$ (3.35) (6.05) (2.28) (3.10) (-1.39)	DW=2.05 $R^2=0.99$
(11*) $\log C = 1.11 + 0.77 \text{ LPDU} + 0.21 \text{ LPI} + 0.15 \text{ D1}$ (2.48) (7.21) (1.18) (2.25)	DW=1.98 $R^2=0.98$
(12*) $\log C = 1.28 + 0.71 \text{ LPDU} + 0.24 \text{ LPI} + 0.20 \text{ D1} - 0.09 \text{ D2}$ (2.98) (6.53) (1.40) (2.79) (-1.24)	DW=2.03 $R^2=0.99$
(13*) $\log C = 0.06 + 0.76 \text{ LPMX} + 0.46 \text{ LPI} + 0.12 \text{ D1}$ (0.16) (7.84) (3.36) (1.97)	DW=2.03 $R^2=0.98$
(14*) $\log C = 0.21 + 0.71 \text{ LPMX} + 0.48 \text{ LPI} + 0.16 \text{ DI} - 0.07 \text{ D2}$ (0.50) (6.54) (3.43) (2.13) (-0.9)	DW=2.05 $R^2=0.99$

The first two equations, 9* and 10*, where the price of goods for fixed capital formation (PCF), the same index used to arrive at K_1 , and the wage rates for P1 workers were the independent variables, gave good results. These variables can be seen as measuring the price of capital goods and labour respectively. The price index of manufactured exports from developed countries converted into kwachas (PMX) also gave good results as seen in equations 13* and 14*. The other wage-rate variable used, P11, was invariably statistically insignificant. Costs are more likely to be determined by movements in the wages of lower paid workers than in those of higher paid workers, and so this result could have been expected. The inclusion of other variables such as the grade of ore or the output of ore or copper which could be seen as taking into account scale economies, did not improve the regression results, nor were their coefficients significant. The different broad price variables - LPCF, LPMX, LPDU - were significant when used alone as equations 9* to 14* show, but because of multi-collinearity did not yield such good results when combined together or when used with LPEL, the price of electricity.

Most importantly, the cost equations results are largely consistent with the production function results. The dummy variable, D_1 , was significant and positive throughout. The variable, D_2 , was negative throughout, but never strictly significant at the 5% level. The sum of D_1 and D_2 was always positive.

10.3 Summary

In Chapter 5, caution was raised over the short-comings in the data series available, and these must be borne in mind in an overall evaluation of the econometric work. However it is noticeable that all the econometric work

indicates a statistically significant fall in efficiency in the post-nationalization period, even after allowances are made for the Mufulira disaster. The production function estimates indicate lower output per unit of resources used, the order of magnitude being within a few percentage points of 15 per cent when no allowance was made for the Mufulira disaster and as much as 10 per cent more after 1971 when allowance had been made for 1970 and 1971

Similarly, the cost equations indicated a statistically significant rise in costs as a result of inefficiencies following nationalization, even when the Mufulira disaster had been taken into account. The order of magnitude of the rise in costs that was observed was about 15 per cent.

Chapter 11

CONCLUSIONS

The nationalization of the Zambian copper mining industry that has been the main subject of our study took place at a time when the industry was at the crest of a wave - at a time of high and growing production when tax revenues were high and when there were plans, which were in the process of being implemented, to add substantially to capacity. In this context, the thesis looked at the reasons for and the results of the nationalization.

11.1 The industry's meeting its various responsibilities

In Chapter 2, we discussed various criteria for determining the performance of the industry. We described how the mining industry is really a collection of different units - metal marketing departments, geological research and evaluation units, etc. - set up to produce and sell copper for the benefit of its owners. The private owners claimed that the benefit of the owners - the private shareholders - was not the only objective of their organizations. Sir Ronald Prain set out other responsibilities that he considered the industry had - to its employees, to government, to the community, to the industry's customers, to the rest of the industry throughout the world and to the future.^{1/}

Few would disagree with this list of responsibilities, although there might be disagreements about the different importance these responsibilities should have. We have to ask whether, at the time of nationalization, there were obvious defects in these organizations that prevented them from meeting

^{1/} PRAIN Sir R. L. "Mining and the Public Interest": Address to the Mining and Metallurgical Society of America, New York, April 29th 1958, reprinted in Selected Papers Vol II, 1958-1960, London 1961, pages 1 -12.

their responsibilities, whether they simply did not try to meet certain responsibilities, or attached a completely incorrect importance to them. In the light of our examination of the Zambian copper industry before and after nationalization, taking into account the arguments advanced in favour of nationalization, it would be difficult to say that there were obvious defects in the organizations or that they clearly had their priorities wrong.

In the light of hind-sight, and, as we argued in chapter 9, on the basis of what should have been perceived at the time, it can be seen that the Government's single-minded determination to increase production and investment raised questions about two of the industry's considerations - with respect to the world industry as a whole and to the future. If, as we saw Mr. Faber claimed, (Chapter 7.2.3) the private companies were worried about expanding production because of world over-production leading to a lower copper price, it would be difficult now to argue that they were not acting with justifiable caution.

11.2 The overall performance after nationalization

In the event, as we saw, production did not increase after nationalization and the record on investment is ambiguous. At the cost of a considerable loss in Government revenue in the last years of high profitability, when it could have recouped large sums in tax revenues, the Government did help encourage heavy investment spending. Yet this investment boom tapered off in the middle 1970s and by the end of the decade the condition of the plant and the productive capacity of the industry would appear to have been lower than at the time of nationalization.

We saw that the nationalized industry did have some accomplishments to its credit. In particular, its record on Zambianization, part of its responsibility to its employees, was good, and it was successful in holding down wage costs. Moreover, the technical side of operations was maintained well, judging by the accident record (with the exception of the Mufulira disaster which cannot be attributed to nationalization) and the rates of recovery at the treatment plant. The productivity record, both in terms of ore and copper output per employee, deteriorated after nationalization. We saw that productivity was directly related to output, but no attempt was made in the early years to adjust the labour force downwards as output fell.

In chapter 9, we looked at the effects of the fall in the price of copper and of the disruption caused by the undeclared war with Rhodesia on the industry and argued that they could account for much of the difficulty that the industry faced. However, we also argued that many of the difficulties that arose could have been foreseen.

The results of our econometric work were consistent with the view that efficiency did fall after nationalization and that the costs of production rose. These results held up even after allowance had been made for 1970 and 1971.

For the above reasons, it would be difficult now to argue that there were obvious deficiencies in the way the industry was run that would be remedied by nationalization. Although the process of Zambianization continued after nationalization, this is a policy that the private companies were pursuing and, we argued, they were probably in a better position to retain and obtain the services of a skilled expatriate work force than the nationalized companies.

11.3 The importance of organizational factors

This issue of Zambianization illustrates what is a very important question that must be asked about nationalization and one that, at the time, was hardly put. It is whether, if the organizations that had existed up to 1969 had been allowed to continue in existence, they would not have met the objectives of the government better than did the new companies that were set up. This is a real question because, as we saw earlier (7.5), the executives of the mining companies were prepared for, and indeed expected, the post-Independence Government to assume a large interest in the mining companies. As it happened, though, the organizations that existed, Roan Selection Trust and Zambian Anglo-American, were radically changed by nationalization. Two private enterprise organizations that were very clearly guided by commercial considerations and whose management was independent of the Government were replaced by two organizations under Government control.

There was much to be said in favour of leaving the existing organizations in place. They had acquired considerable experience in running the industry, had a feeling for the copper market and were independent. Moreover, their employees had considerable "esprit de corps". Allowing these organizations to remain in place would have indicated to the international business community that Zambia was not averse to private enterprise. Furthermore, it was observed that one of the factors that probably contributed to the poor production performance was the lack of management continuity.

11.4 The risk-assuming role of the private companies

As well as the stability and coherence in objectives and direction that the private organizations provided, another of the strongest reasons for maintaining them intact was, we believe, that it was easier for private enterprise rather than the country of Zambia to adjust to the consequences of the fall in the price of copper and the dispute with Rhodesia.

If, as we saw to be the case, the years after 1969 could have been expected to be difficult ones for the copper industry, it was surely in the country's interest that foreign private capital rather than the national economy should suffer the consequences. As it was, the nationalization of the industry meant that Zambia had to go heavily into debt to keep the industry operational: if the industry had remained in the hands of the private companies it was they who would have had to borrow whatever sums were required, thereby affecting their own asset position but not that of Zambia.

We described how Zambia has subsequently had to agree to rather severe adjustment programmes in order to obtain support from the International Monetary Fund. It could, then, be argued that Zambia's quest for "economic independence" has led her to actually lose her freedom of movement. Before nationalization, her major industry was run by private companies with foreign backing but, as their principal assets - the mines and treatment plant - were immovable, the Government had very considerable control over these companies. Indeed, it is difficult to see that the Government gained any really greater degree of control over the industry by nationalization. By assuming all the risks that the private companies once bore, the Government in effect tied the country's fate directly to the vagaries of the copper market. When this market collapsed, the Government had to accept that its policies be determined by its creditors, acting through the International Monetary Fund.

11.5 Nationalization coming at a time when the industry was mature

We also saw that the industry at the time of nationalization was fully mature. The big mines had all been opened up and there were no low-cost exciting properties waiting to be opened up. As the existing mines had gone deeper, grades of ore had fallen and costs had tended to rise because of the greater distances that the ore had to travel. The mines and treatment plant were in good working order and, before the Mufulira disaster, it was possible to visualize a slight increase in the country's production of copper. Yet, it could be seen that difficulties did lie ahead and that it would probably be impossible to repeat the rates of profit per unit of output that had obtained in, say, the mid-1950s. In these circumstances, it could be argued that the best course was to leave in charge those who had acquired considerable experience in running the industry, in times of difficulty as well as of prosperity. The argument would be that all the resources that the two private organizations had at their disposal were needed to keep the industry running efficiently and any move that might have weakened the "esprit de corps" that existed in them, such as nationalization or the revoking of the management contracts, was not in the best interests of the country.

This argument, that the deposits were becoming more difficult to work and that therefore considerable attention should be paid to ensuring their efficient operation, was not one that was addressed by the proponents of nationalization. It would not be unfair to state that they thought that the Government would be taking over very profitable organizations^{2/} and that it could be able to use the profits from the industry for the country's development^{3/}. There was no indication that at some future time the

^{2/} cf. POTTER J.G. "The 51 per cent Nationalisation of the Zambian Copper Mines" in FABER M.L.O. and POTTER J.G. Towards Economic Independence, Cambridge, Cambridge University Press 1971, page 96.

^{3/} cf. KAUNDA K. Matero Speech, August 11th 1969, reprinted ibid. page 133.

Government might not obtain any revenue from the industry or that it would have to borrow to help it to continue its operations. The Government and its advisers can, then, be criticized for being too optimistic in their outlook.

11.6 Whether nationalization was a result of over-optimism

Indeed, it might almost seem that the nationalization of the Zambian copper mining industry was just one of the over-optimistic acts performed by a young and inexperienced government when the future seemed to hold nothing but promise for Africa. Independence was being achieved at a time of boom in mineral markets and it was thought that the possibility of physical scarcities would keep mineral prices high. In light of the oil price increase of 1973/74 and the warnings of the Club of Rome, published in their Limits to Growth in 1972,^{4/} few would have imagined that within a few years such an important metal as copper would be selling at below its costs of production.

Certainly, then, a strong case can be made for the argument that what was really wrong with the nationalization was the timing - that if the government had simply waited until the copper price fell, thereby depressing the price of the existing companies' shares, it could have acquired its majority ownership at a very low price and with the eager approval of the private owners, thereby in no way damaging its image in the international investment community. For instance, the Government acquired its 51 per cent ownership in Roan Selection Trust's properties for \$118 million. In 1977, Roan Consolidated Mines' capital was made up of 30.315 million shares. The lowest prices the shares reached in that year was 50p (\$0.87) and so a 51 per cent interest would have been worth \$13.45 million. The highest price of 1977, 160p, would have meant 51 per cent

^{4/} MEADOWS D.H. et al The Limits to Growth New York, Universe Books, 1972.

could have been purchased for \$43 million.^{5/} The lowest share price of 1975 was 155p, and the 51 per cent of the company would then have been worth about \$53 million.

We only give these figures for the sake of illustration - if Roan Selection Trust had not been nationalized, its shares could have been valued differently from what those of Roan Consolidated Mines were. Moreover, such a large purchase as 51 per cent would have affected the prevailing share prices. This illustration does, though, bring out clearly that there were alternatives to what the Government actually did and that if it had waited it could perhaps have bought out the private owners at a very low price.

11.7 The objectives and reasons for nationalization not clearly thought through

We would argue, though, that more questions can be raised about the nationalization than simply whether its timing was opportune or not. We argued in Chapter 7.4.2 that the Government's objections to the way the companies were being run were never properly documented and that it was not clear what changes nationalization would be expected to make. This would suggest that the decision and its consequences were never properly thought through by the Government.

^{5/} Share prices from Financial Times Mining International Yearbook 1979, page 474.

The President himself had said a year before the nationalization, in 1968, that copper was "too big" but apparently changed his mind over this.^{6/} Moreover, in the first years of Independence there appeared to be little serious discussion of what policy should be pursued towards the copper mining industry, although the policy that finally emerged in 1969 was apparently not the result of any hasty decision, but a logical outcome of the Mulungushi Reform of April 1968, whereby the Government acquired a 51 per cent share in several large firms, and of the experience of the Chileans in acquiring a 51 per cent ownership of the Anaconda mines in June 1969.^{7/}

The Government seemed to think that nationalization would bring about the benefits of an increase in production, in tax revenues and in investment, but did not really address the possible disadvantages of having the Government rather than the companies assume all the risks and, later, undertake the management of the properties. It seemed to believe it would obtain all the benefits of nationalization and that either the possible disadvantages did not exist or, in Zambia's case, would be unimportant. There was, though, little excuse for taking so optimistic a view. As we saw in Chapter 7.2.1, the Seers report had talked of both the Government and the companies suffering from nationalization, and had suggested alternative measures. Moreover it had expressly warned that if the Government acquired an equity interest in the companies in lieu of royalty payments or export taxes, this could be a disadvantage in that the industry's contribution to the Government would become more volatile.

^{6/} MARTIN, A. Minding their own business: Zambia's Struggle Against Western Control, London, Hutchinson, 1972, pg. 157-158.

^{7/} ibid. Chapters 6 and 7.

11.8 An overall assessment

Soon after the agreement between Anaconda and Chile referred to above, the Chilean Government changed hands and Salvador Allende Gossens came to power. He set about taking over the mining properties on terms that the private share holders did not agree to. This was never a viable option for Zambia as, unlike Chile, it did not have the skilled manpower to run the mines in the event of the private owners withdrawing all their personnel in the face of outright confiscation.

We saw in our earlier analysis that if a nationalization were in fact a confiscation - the capture by the state of the economic rent from the mineral properties at no cost - then this could be said to be an economic justification for nationalization. The other arguments in favour of nationalization were more tenuous and revolved around such things as whether the private owners were paying enough attention to externalities, were applying an implicit discount rate that was different from what the country would have applied, or were risk averse. Our examination of the Zambian case has shown that any such arguments against the private owners are difficult to sustain. Moreover, the realities of the copper market are forcing the state concerns to consider doing what a private owner would almost certainly have done - close down some operations and seek to cut the labour force - the avoidance of which were reasons given for the desirability of nationalization.

The objections to nationalization were clearly stated at the time - bureaucratic inefficiency, political rather than economic considerations dictating policy, loss of foreign investment interest in Zambia and the state assuming the risks of mining.

If then, there is to be a conclusion to this thesis, it is to emphasize the problems attendant upon the nationalization of a natural resource industry. If an industry is reasonably well-run by its private owners, then there is a very strong case for leaving it alone. Projections of increases in future production and untapped sources of revenue for the state can make nationalization appear a very viable option, but the risks involved and the intangibles - such as the importance of a well-trying management or a recognized esprit de corps in the private concern - can invalidate the most optimistic of forecasts. Certainly, to nationalize an industry when all the indications are that the market will soon decline, as happened in Zambia's case, would require considerable justification.

It cannot be said that this conclusion is novel. To complete the quotation from Adam Smith given earlier:

"But though the judgment of sober reason and experience concerning such (mining) projects has always been extremely unfavourable, that of human avidity has commonly been quite otherwise. The same passion which has suggested to so many people the absurd idea of the philosopher's stone, has suggested to others the equally absurd one of immense rich mines...."^{8/}.

At the present time of dismally low metal prices, it would be hard not to argue that sober reason would indicate that it is better that private foreign capitalists be led by avidity to put their money into mineral projects rather than national governments.

^{8/} SMITH A. The Wealth of Nations, London 1977, Bk IV Chapter VII, part 1.

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